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ESSAYS ON FISCAL POLICY AND DOMESTIC RESOURCE MOBILIZATION IN RESOURCE-RICH DEVELOPING COUNTRIES

ESSAIS SUR LA POLITIQUE BUDGETAIRE ET LA MOBILISATION DES RESSOURCES INTÉRIEURES DANS LES PAYS EN DÉVELOPPEMENT RICHES EN RESSOURCES NATURELLES

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Summary

This thesis examines the effect of extractive natural resources on the macroeconomic environment of developing countries and addresses the issue of domestic resource mobilization in these countries. After reviewing the existing theoretical and empirical literature on the natural resource curse, it explores empirically the impact of giant oil and gas discoveries on the fiscal policy of developing countries and tests the effect of a solution promoted by multilateral institutions and governments to alleviate the challenges of the management of such resources.

The first chapter highlights the negative impact of oil and gas discoveries on the likelihood of sovereign debt crises in sub-Saharan countries. This effect occurs mainly in countries with a high concentration of exports; conversely, it disappears for so-called diversified countries. This result is noteworthy because the countries in our study have already received debt relief through the Heavily Indebted Poor Countries (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI).

The second chapter shows the impact of oil and gas discoveries on the composition of public expenditures in developing countries. It emphasizes the harmful effects of these discoveries on health and education spending. In addition, governments privilege less productive and more discretionary categories of spending, like military and social protection spending. The results of this chapter raise concerns about whether the first of the Sustainable Development Goals (SDGs) about economic growth will be achieved.

The third chapter analyzes the impact of Sovereign Wealth Funds (SWFs) as a solution promoted by several governments. This article shows that SWFs, particularly stabilization funds, have a significant impact on addressing the deterrent effect of non-resource tax mobilization. Furthermore, imposing an additional fiscal constraint on resource-rich states encourages better revenue mobilization across non-resource sectors. This last result contributes to the discussion of options for achieving the

objectives of the Marrakech Consensus, which emphasized the importance of better domestic revenue mobilization.

Finally, we conclude by providing practical economic policy recommendations to address the multidisciplinary problem of natural resource curse.

Keywords: Giant oil and gas discoveries, Domestic resource mobilization, Sovereign debt crisis, Sovereign wealth funds, Composition of public spending

GENERAL INTRODUCTION

1. Natural resources and evolution of economic activity

The discovery of natural resources has exhibited the different periods of human civilization. The natural resources of the subsoil, when they were discovered, allowed to improve the technology and the materials used to reach further stages of development. Indeed, the Paleolithic era (about 3,000,000 to 10,000 B.C.) and the Neolithic era (about 10,000 to 3,300 B.C.) were characterized by the lithic industry (development of stone tools carved by humans). However, the different stages that follow them highlight the "metal era." At the end of the Neolithic period, the Bronze Age begins (about 3,000 to 1,000 BC in North Africa, the Middle East, and Europe). Human civilization has become familiar with the new metallurgy technique. It allowed the extraction and use of precious metals or alloys, which could only be exploited in areas where there were copper deposits. The exploitation of bronze allowed the development of technology and the manufacture of new weapons and other human tools.

However, with the appearance of metallurgy, the economy became more complex, and activities became more specialized within the clans; a social and economic break appeared based on specialization in production activities. With the development of metallurgy, economies became more complex, and activities became more specialized within the clans, thus creating a social and economic breakdown based on specialization in production activities.

From 1000 BC, we enter the Iron Age, which directly precedes the modern era by years. We can correctly say that the modern era coincides with the age of hydrocarbons with three significant breakthroughs:

- the age of coal, oil and gas with the introduction of the steam engine in the 1800s allowed the massive production of coal-based energy.
- In 1850, there was the first internal combustion engine using petroleum, which was used for very limited purposes before the engine

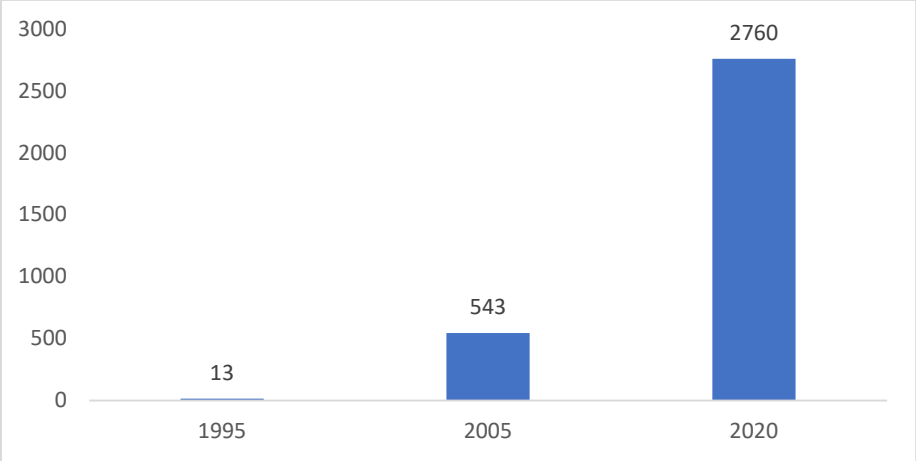
- and the creation of gas turbines, which allowed natural gas to create huge amounts of energy.

These events show the extent to which minerals and hydrocarbons have shaped the economy by allowing for technological evolution in the regions that have experienced these discoveries. This thesis focuses on the oil and gas discoveries that supported the industrial revolution and the modern era. This is especially important given that low-income countries have experienced a delay in discoveries. These discoveries fundamentally altered the economic structure of these countries, which led 20th-century economists to address the paradox between the importance of the natural capital of these countries and their economic growth. This paradox, better known as the "curse of natural resources," has received increasing attention in the economic literature, as shown by the table of papers published on the subject since 1995.

2. Growing interest of the scientific community in the natural resource curse issue in developing countries.

Figure 1 highlights the growing attention of the scientific community to the impact of natural resources. Since the pioneering empirical paper of Sachs & Warner (1995), the number of studies has grown steadily. From 2005 to 2014, there were nearly four times as much scientific literature on the subject as there was from 1995 to 2004. The trend in 2021 is upward.

Figure 1: Number of academic papers on "natural resource curse" published on Google Scholar from 1995-2020



Source: Data from 1995-2020 retrieved from Papyrakis (2017) and expanded by the author

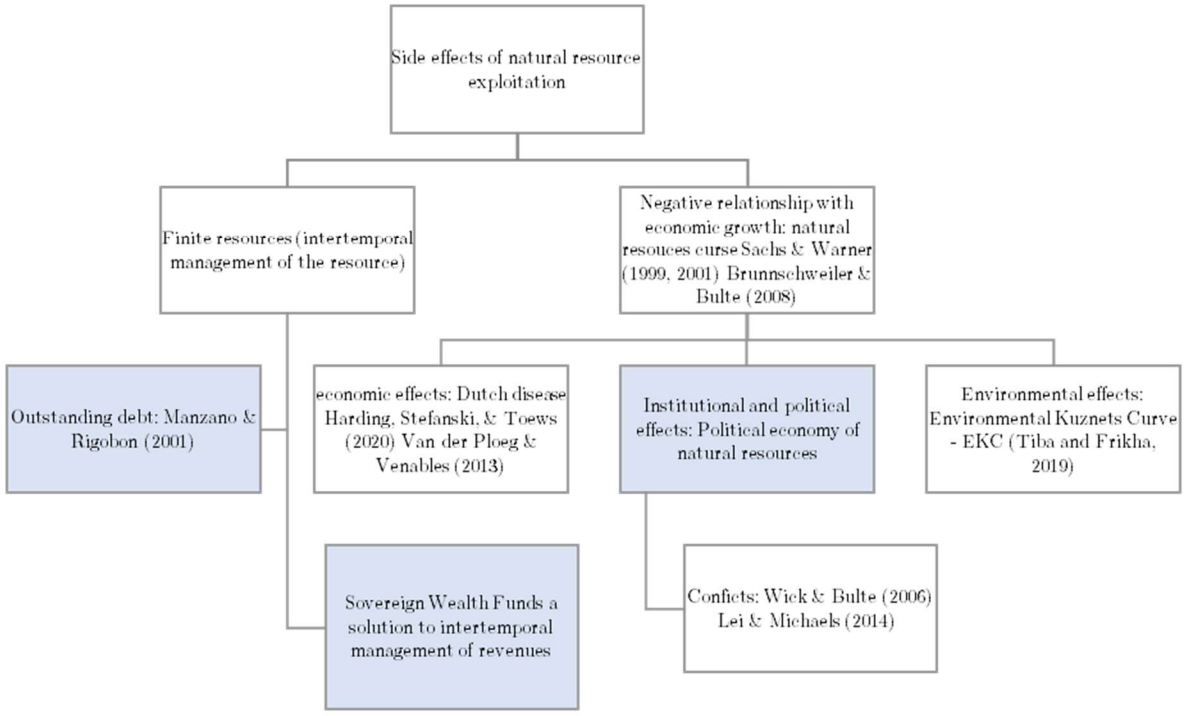
3. Foundations of the resource curse theory

Badeeb et al. (2017) describe the evolution of natural resource theory, beginning in the late nineteenth century with Adam Smith and David Ricardo's work on comparative advantage. This was the period when the impact of natural resources was associated with the long-term growth of production. The reason is that these resources are used directly or indirectly in the production process. A resource-rich country thus had a specific comparative advantage over other countries: a wider frontier of production possibilities. The natural resource curse can also be linked to the literature on Prebisch (1950) and Singer's(1950) hypothesis on the decline of the terms of trade. In the long term, the decline in commodity prices is due to the income elasticity of global demand caused by technical progress and market structure. The literature on the resource curse is also based on Balassa (1964) and Samuelson's (1964) theory, which shows the impact of productivity differences between countries on the purchasing power of workers in the tradable goods sector.

In our case, this means analyzing the impact of relative productivity differentials on the purchasing power of workers in the industrial sector. In the same vein, the analyses of Corden & Neary (1982),

Corden (1984), and Auty (1993, 1994) on the Dutch disease. It results in the manufacturing sector's decline due to the rise in prices of non-tradable goods driven by the boom in the resource sector. In the 1990s, the first empirical studies emerged on the paradox between the abundance of natural resources in some developing countries and their poor ability to generate economic wealth. The seminal Sachs & Warner (1995) study found that as natural resource dependence, as measured by natural resource exports as a share of total exports, increased, it led to a decline in economic growth. This first empirical study, supported by several authors Humphreys, Sachs, & Stiglitz (2007) decomposes the global effect of natural resources (mining) into vertical inequality (poverty gap between social strata) and horizontal inequality (poverty gap between countries). The topic is timely and explains the evolution of income categories between countries. The Middle East and North Africa, and Latin American countries are rich in natural resources. However, they have experienced low economic growth compared to the Asian tiger group of Japan, Korea, Taiwan, Singapore, and Hong Kong, insular countries that have achieved rapid economic development despite being poor in natural resources. Several economic studies have analyzed the impact of natural resource dependence on various macroeconomic aggregates such as economic growth (Sachs & Warner, 1999, 2001; Brunnschweiler & Bulte, 2008); exchange rates (Harding, Stefanski, & Toews, 2020, Van der Ploeg & Venables, 2013); taxation (Crivelli & Gupta, 2014); fiscal policy (El Anshasy & Katsaiti, 2013); democracy (Tsui, 2011, Bjorvatn, et al. 2012) and Ross, 2015); conflict (Wick & Bulte, 2006, Lei & Michaels, 2014, Farzanegan, et al. 2018); environmental quality (Tiba & Frikha, 2019), and financial development (Wang, et al., 2021); debt Manzano & Rigobon (2001), among others. The graph below diagrams the tree of harmful effects of natural resources on the different topics, highlighting in blue the contributions of this thesis.

Figure 2: Tree structure of the different effects of natural resources curse



Source: Author

Price volatility remains a key determinant of the resource curse (Van der Ploeg & Poelhekke, 2009). The authors explain this because price volatility is transmitted to the economy as a sudden shift in public resources, which is harmful to growth, mainly when it depends on these resources. They then demonstrate that, apart from this phenomenon of resource volatility, the impact of natural resources is positive and significant. The negative indirect effect of the "volatility of public resources" is only induced by commodity price shocks. The effects of shocks are asymmetric, making instability more harmful to long-term growth. Negative (positive) price shocks lead to a tightening (release) of the budget constraint. Adjustments are necessary, especially for countries with low integration in financial markets and low growth in non-resource sectors.

These economies, which are heavily dependent on petrodollars, are more likely to adopt spending strategies that are correlated with resource price trends. Thus, the concept of "white elephants" has emerged, which are populist expenditures that are not very profitable in the long term and are carried

out by the government in power in order to win votes. In addition, Tornell & Lane (1999) and Farzanegan (2011) provide support for these policy adjustments. In contrast, Hicks (1991) questions the nature of fiscal adjustments in the case of already high debt burdens in developing countries, where each expenditure item is essential both politically and economically. Moreover, the adjustment raises fundamental questions of political economy since the decisions of politicians in power at time *t* have repercussions on their possible re-election in t+1. The author finds that military and social spending are steady, while the infrastructure and other productive sectors experience the most significant decline. Revenue from the resource sector is a way to strengthen security and develop a stronger state.

Chun (2010) has calculated the elasticity of resources from the oil sector on the increase in military spending. The results show that military spending is inelastic concerning changes in oil revenues, making the sanctions previously imposed on Iran because of its nuclear ambitions inappropriate. The study is based on the period 1997-2007 for five countries. For a more comprehensive review of the literature on the natural resource curse in general, see the articles by Frankel (2012), Badeeb et al. (2017), and Papyrakis (2017), and for an empirical review, see the article by Van Der Ploeg & Poelhekke (2017).

4. From resource dependence to resource abundance: indicators of natural resource wealth

The first wave of empirical papers focused on natural resource dependence with level indicators measuring the total wealth of countries (Sachs & Warner, 1995, 2001; Gylfason,2001; Stijns, 2005). Then comes the study of Brunnschweiler & Bulte (2008), who introduces the distinction between natural resource dependence and natural resource abundance. The authors explain that the former measure suffers from endogeneity problems, as the denominator includes the natural resource sector and other determinants of economic growth. Using a measure relative to population size, or considering natural reserves, corrects the endogeneity bias and better captures abundance instead of

dependence. Correcting for this bias would make the negative effect of natural resources become significant on economic growth. This paper was decisive for the subsequent economic literature, which now mainly uses natural rents per capita. Papers following Brunnschweiler & Bulte (2008) have more varied results depending on the natural resource wealth indicator and the econometric model used.

4.1. Indicators used in the literature on the natural resource curse

Depending on the period of the papers, the measure of the natural resource variable varies. Studies on natural resource dependence are reported to economic activity or as a percentage of the total base. Below we list some of these indicators inspired by Badeeb et al. (2017):

- natural resource exports as a percentage of GDP;
- natural resource rents as a percentage of GDP;
- the ratio of natural capital to national wealth;
- natural resource exports in total exports.

Following Brunnschweiler & Bulte's (2008) critique, we have a second wave of articles that considers the endogeneity problem and instead use natural resource variables relative to the population: this is the concept of natural resource abundance.

4.2. Boundaries of existing indicators and new approaches: giant oil and gas discoveries

4.2.1. Emerging indicators: the curse of natural resources questioned

Brunnschweiler & Bulte's (2008) study highlighted numerous studies with results that differ from the usual conclusion of a natural resource curse. For Boyce & Herbert Emery (2011), for instance, the negative results of studies on natural resource dependence are correlations and do not necessarily induce causality. Instead, the authors argue that the overall impact of natural resource abundance on economic growth is negative but positive when considering income levels.

Lederman & Maloney (2006) use the ratio of primary commodity exports to total commodity exports and primary exports to GDP over 1980-1999 and conclude that natural resource abundance is neither a curse nor a blessing provided as long as this wealth is combined with innovation. On a panel of OPEC and non-OPEC countries, Alexeev & Conrad (2009) also point out the problem of the denominator of the indicators of natural resource dependence. They propose two new measures and find a positive result: natural resource reserves per capita and oil GDP relative to total initial GDP.

Cavalcanti, Mohaddes, & Raissi (2011) combine non-stationary panel data estimation methods with abundance indicators (actual oil production and oil reserves as proxies for resource endowment). They find that natural resource abundance induces an increase in the income level and a positive growth rate. However, these positive results can be enhanced by adopting better institutions.

4.2.2. New quantitative approaches: giant oil and gas discoveries

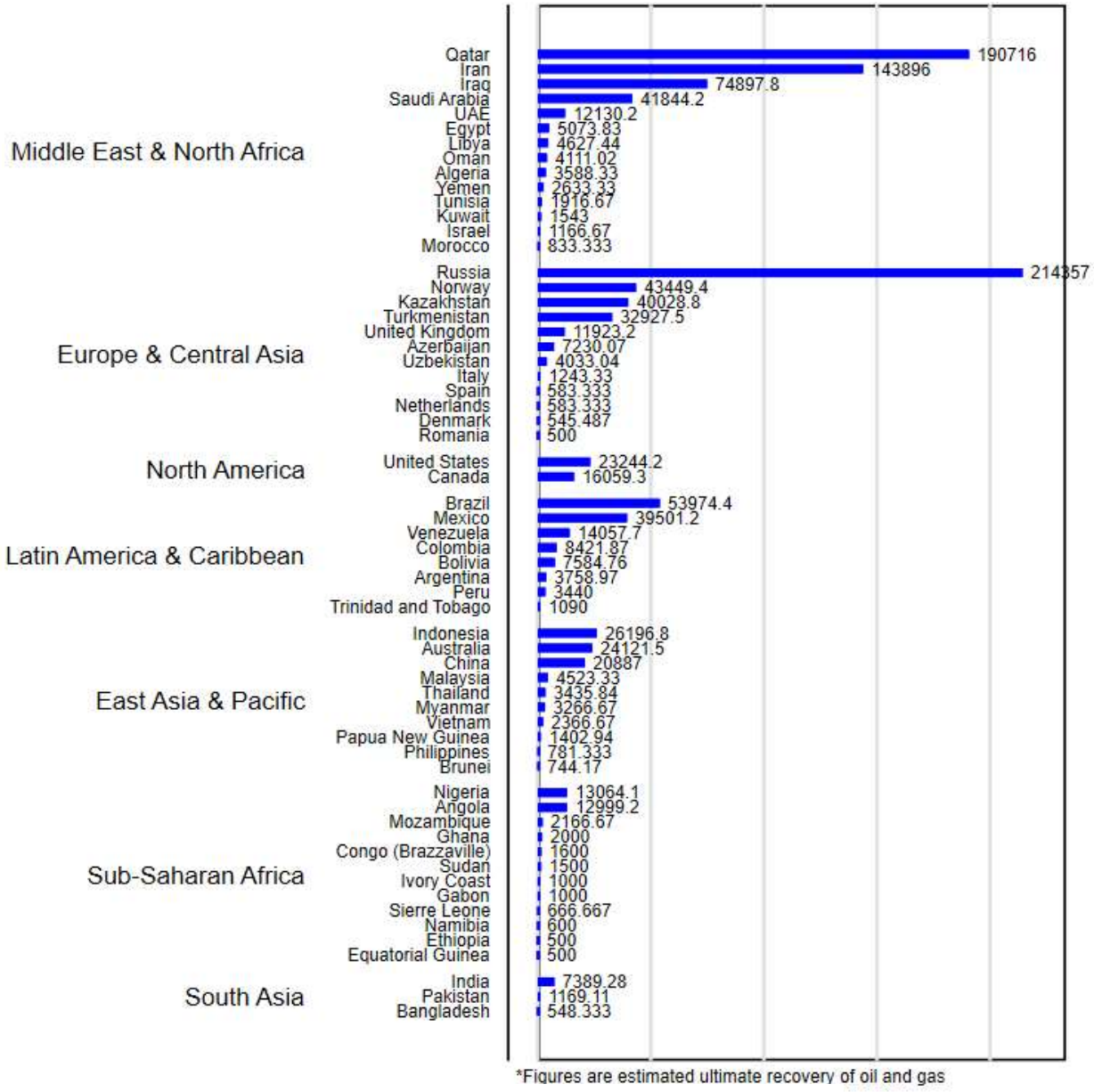
Many recent studies have highlighted a new approach to identify better the impact of natural resources: the use of giant oil and gas discoveries. Many recent studies have highlighted a new approach to identify better the impact of natural resources: the use of giant oil and gas discoveries. They are considered as a quasi-natural experience. The study of Arezki, Ramey, & Sheng (2017) popularized this approach, ushering in a new wave of empirical papers linking giant oil and gas discoveries (estimated at a minimum of 500 million barrels) and macroeconomic aggregates. The challenge was to assess when expectations changed following the discovery announcement and to evaluate the effects. They show that the policy response to the resource discovery predates the first barrel of production by about five years. They find a decline in GDP in the current account and an increase in employability due to the real exchange rate appreciation.

Tsui (2011) links giant oil discoveries to democracy and concludes that the discovery of 100 million barrels of oil leads to a decrease in the level of democracy by about 20%. Moreover, in a recent study of Stark and Smith (2017) on giant oil and gas discoveries, they noted that discoveries made in deeper waters have increased by about 5%. These are mostly shale gas, produced primarily in the United States. The findings of this thesis are a continuation of these studies. The following figures describe the discovery data.

- Distribution of deposits by region

Figure 3 shows the distribution of discoveries by region according to the estimated net present value of the deposit. We notice that the most significant deposits are concentrated in the Middle East North Africa countries. The Sub-Saharan Africa region is the second least endowed region in terms of oil and gas deposits. Nigeria and Angola are at the top of the ranking, followed by Mozambique with less than a quarter of the current net worth of Angola's field.

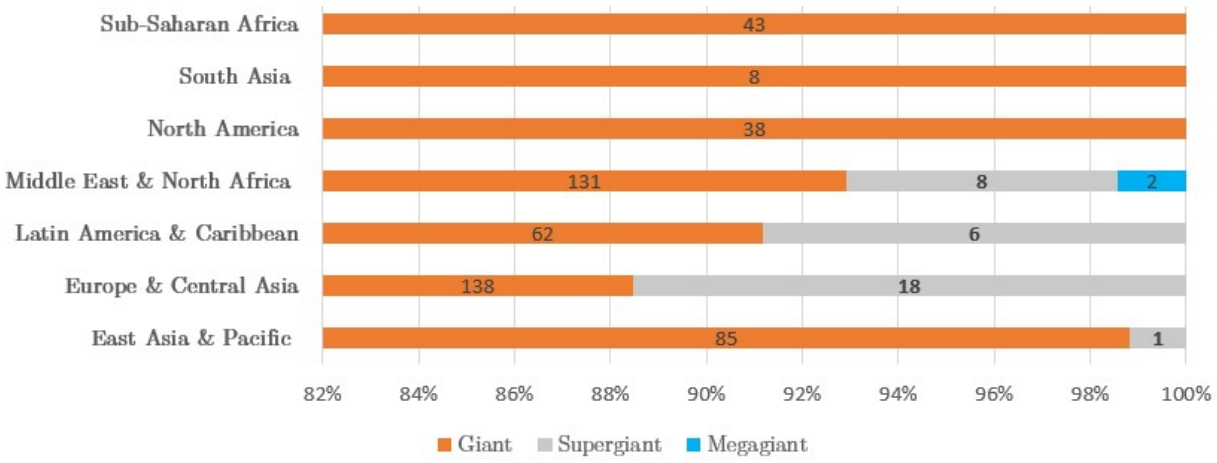
Figure 3: Size of oil and gas deposits by country and region, 1970-2010



Source: Author, based on Horn's (2014) data

Figure 4 shows that the supergiant and mega-giant oil and gas discoveries are concentrated in the regions with the most oil and gas wells, mainly the MENA and ECA areas. The size and number of discoveries are correlated. MENA is the single region that has had two "super" oil discoveries.

Figure 4: Distribution of Oil and Gas Discovery by Size and Region

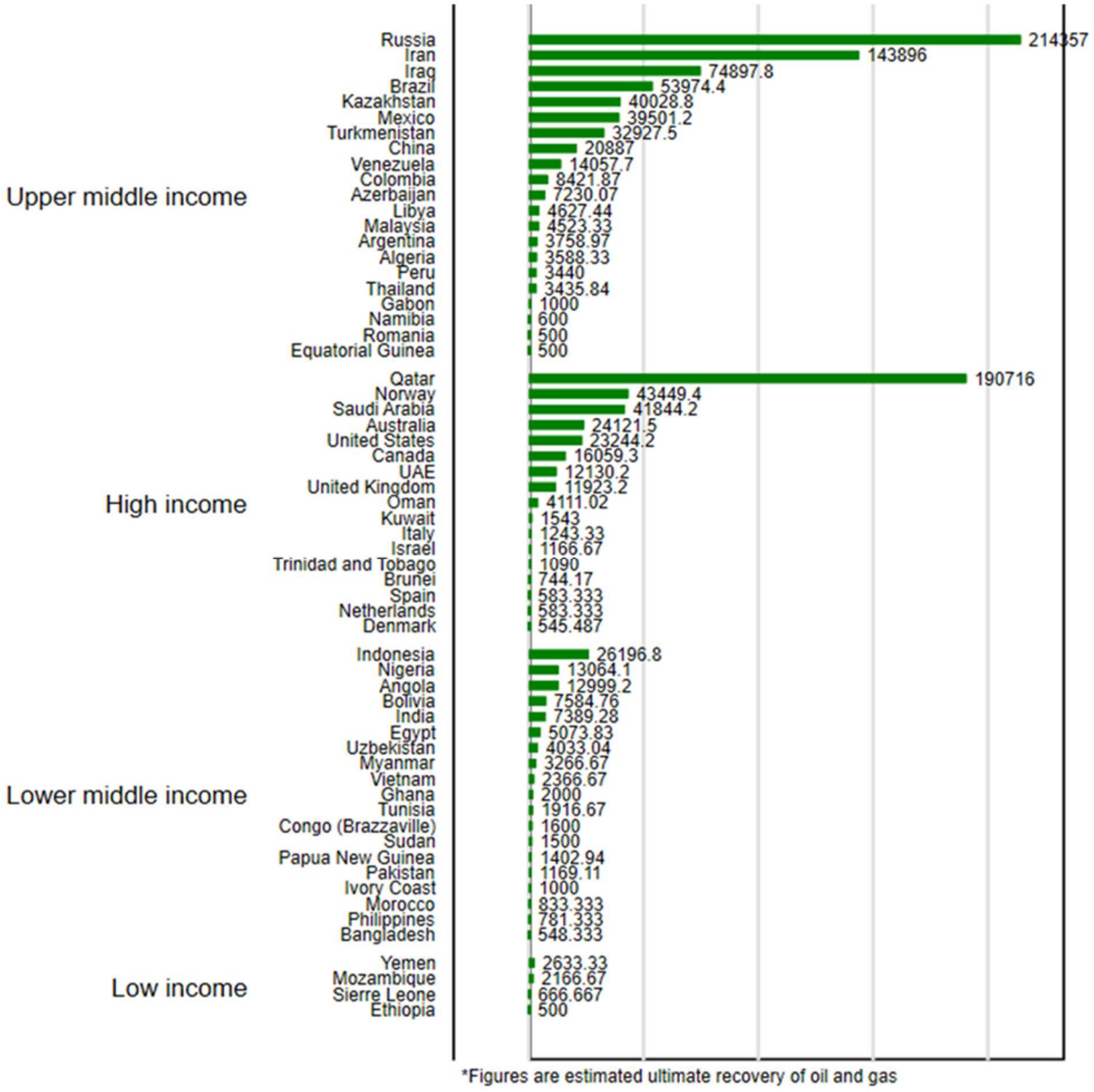


Source: Author, based on Horn's (2014) data

- **Distribution of deposits by income group**

We notice in Figure 5 that low-income and lower-middle-income countries are the least endowed with hydrocarbon deposits. This suggests a negative correlation between income level and total present value of oil and gas in the countries.

Figure 5: Distribution of Oil Pools by Revenue Group

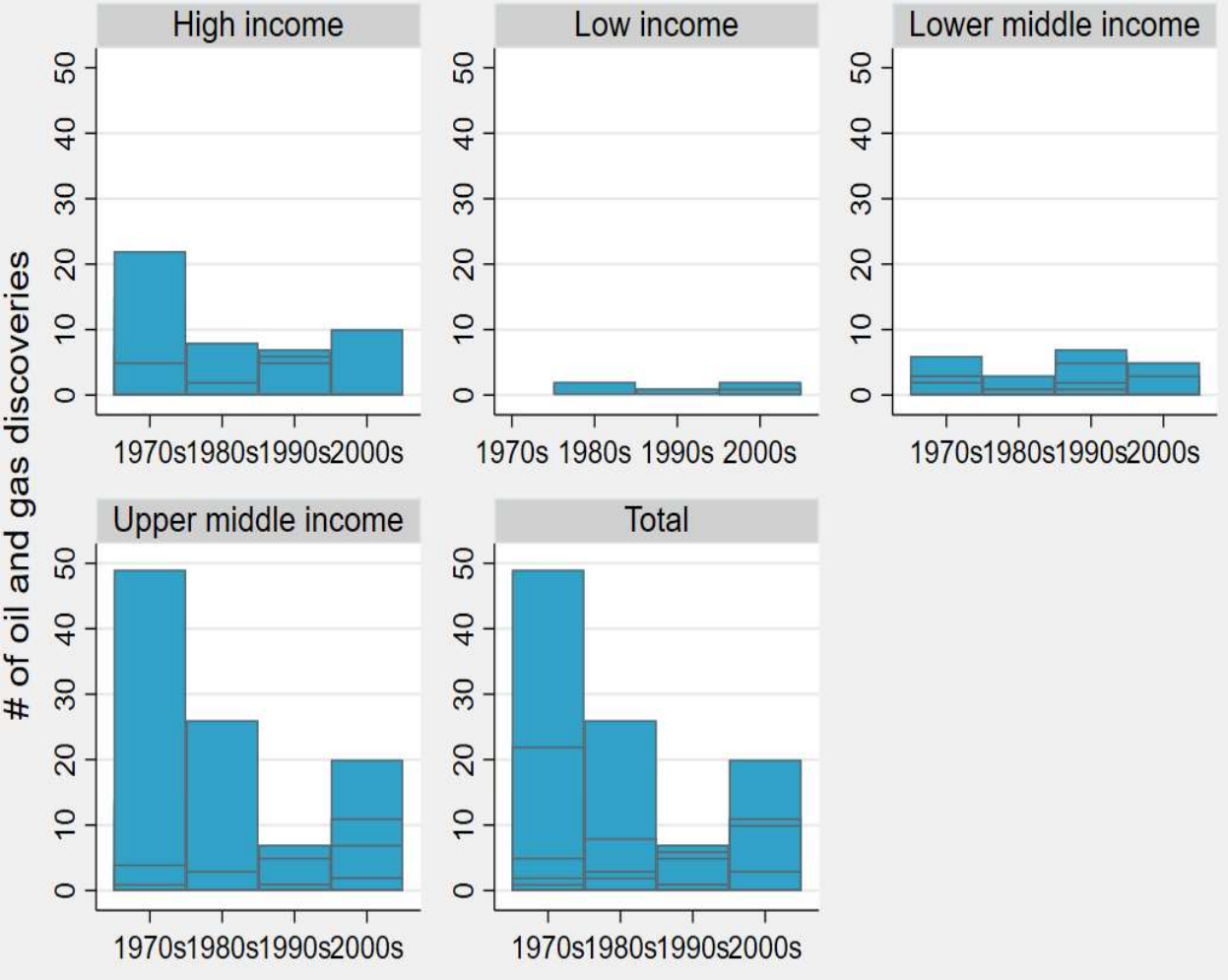


Source: Author, based on Horn's (2014) data

- **Distribution of Major Pool Discoveries by Revenue Group**

Figure 6 shows that the giant oil and gas discoveries occurred early in the period (the 1970s) for all upper-middle-income and high-income countries. This suggests that low-income countries will soon be in a dynamic of catching up. In addition, the low number of giant discoveries in low-income countries supports the idea that discoveries are endogenous, as discussed in chapter 2.

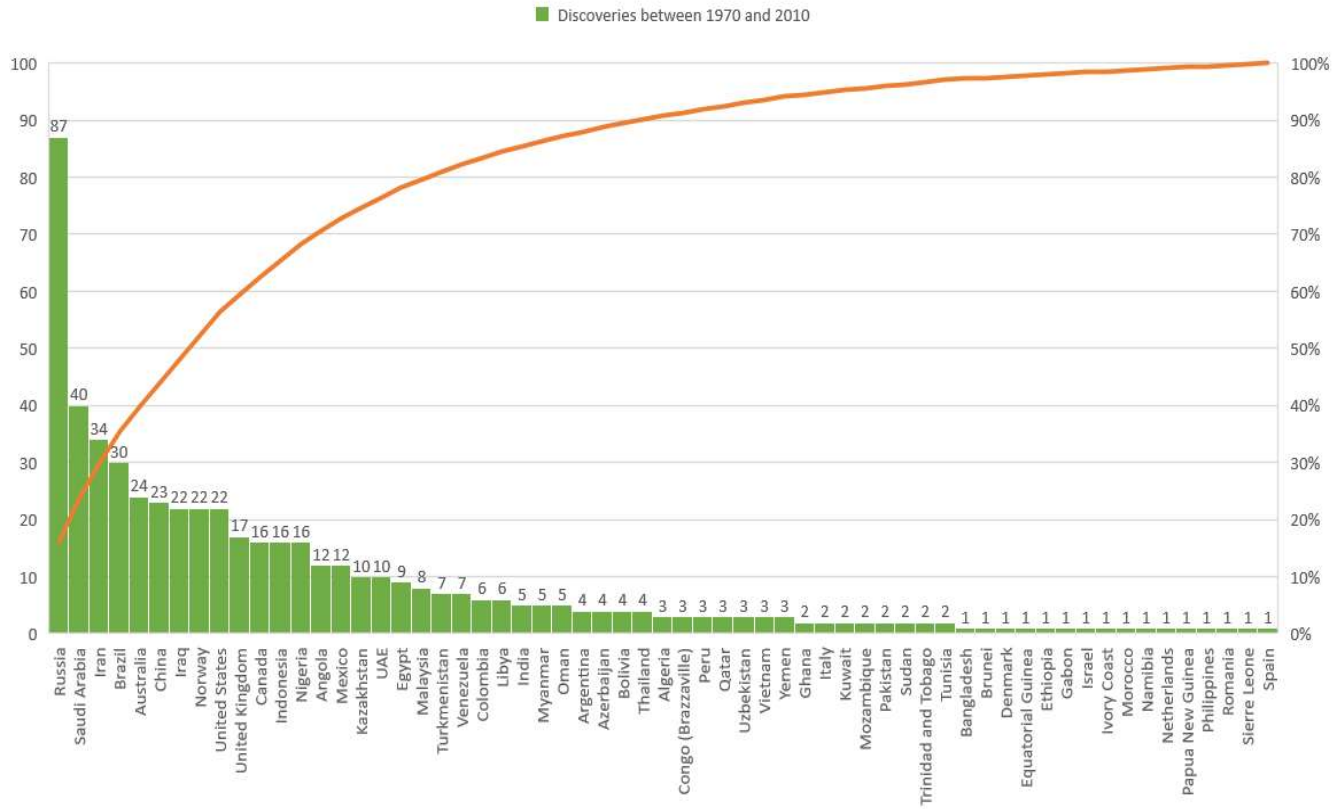
Figure 6:Distribution of discoveries by decade and income group



Source: Author, based on Horn's (2014)

According to Figure 7, Russia is the country with the most significant number of discoveries over the period 1970-2010. Discoveries are highly concentrated, with seven countries accounting for nearly 50% of major oil and gas discoveries.

Figure 7: Number of discoveries by country between 1970 and 2010



Source: Author, based on Horn's (2014)

- **Overview of the topics addressed in the different chapters**

This thesis explores the challenges associated with natural resource management. In the first chapter we discuss the effect of major oil discoveries on debt crisis episodes in sub-Saharan African countries between 1970 and 2010. We empirically test the link between these income shocks and external debt using the complementary random-effect log-log model. The results show that giant oil discoveries increase the risk of distress by about 20 percent. This result highlights a critical issue because most sub-Saharan countries have already received debt relief through the Heavily Indebted Poor Countries (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI).

We attribute the negative effect of this "windfall" wealth to rising government spending and the growing access of African countries to commercial loans. This can lead to intergenerational problems when resource exploitation leads to unsustainable levels of debt for the future generation. We find that the effect remains in concentrated economies and disappears in diversified economies. We also note that the material reduces this risk. Our results are robust to various robustness checks. In the second chapter we discuss the impact of oil and gas discoveries on the composition of government spending over the period 1980-2010 in 96 developing countries. In this chapter, we assume the endogeneity of major oil and gas discoveries with respect to institutions. The appropriate estimator in this situation is inspired by the control function model of Wooldrige (2010): endogenous treatment effect. The instruments chosen in the economic literature are the size of the country, the landlocked status of the country, and the level of democracy. We show a crowding out effect of military spending on social spending (health and education). The negative effect is persistent over a decade for health spending, calling into question the achievement of the Sustainable Development Goals. The results also indicate that oil and gas discoveries represent a significant opportunity for these countries to develop the defense sector.

In the third chapter, we provide an empirical response to the problem of domestic tax revenue mobilization in resource-rich countries. We focus on non-resource taxes in 60 developing countries over the period 1980-2010.

We show a positive and statistically significant impact of the establishment of SWFs on the mobilization of non-resource taxes, with the exception of taxes on international trade. This positive effect is explained by the fact that SWFs absorb part of the revenues from the resource sector, making them less volatile.

Sovereign wealth funds also provide a degree of fiscal constraint that is linked to tax collection. The cash flow generated by the fund is also used to enhance the growth of the

non-resource sector to generate more predictable revenues. For each country, in addition to analyzing the effect of SWFs, we also focus on stabilization funds because their primary stated objectives are to smooth public spending and maintain predictable revenues. Both of these objectives necessarily involve ensuring a steady increase in taxes on non-natural resources.

Chapter 1: GIANT OIL DISCOVERIES, DEBT DISTRESS, AND EXPORTS DIVERSIFICATION: EVIDENCE FROM SUB-SAHARAN COUNTRIES

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1. Introduction

External debt has reached record levels in developing countries following significant natural resources discoveries. To date, thirty African countries have received the full amount of debt relief for which they were eligible through the Heavily Indebted Poor Country (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI)[3]. Nevertheless, about sixteen of forty-six sub-Saharan African countries are currently classified at high risk of debt distress[4] or in debt distress[5]." (IMF, 2019). They are mostly oil, gas and metals exporters with at least 20 percent of total exports or fiscal revenues. It is striking how debt levels are rising dangerously in this region as it seems like resource rich countries mortgage their mineral wealth to pay for significant public expenditures. The gamble does not work every time, and some countries paid the heavy price in terms of debt services leading to default on their obligations. Unfortunately, the risk is exacerbated because of the new borrowing strategies adopted by countries which involve getting more access to commercial loans received from new creditors non- members of Paris-Club. Chad, Ghana, Kenya, and Mozambique have experienced it, trickily for some and to a lesser extent for others. In 2017, Chad has been declared in situation of "debt distress" by International Monetary Fund (IMF). The debt sustainability analysis (DSA) of IMF has showed that the debt burden was unsustainable without significant debt restructuring. This happened after two substantial borrowings of US$600 and US$1.4 billion with commercial creditors respectively in 2013 and 2014 by the hydrocarbons state-owned company (SHT). These contracts were negotiated when oil prices were high (above US$100 a barrel). Few years later, prices started falling leading to a growing issue about outstanding payments. External commercial debt reached 40% of Chad external debt at the end of 2016, even though Chad achieved the HPIC completion point in 2015 which enable the country to debt relief from multilaterals such as

[3] World Bank. (2018, Jan 09). Heavily Indebted Poor Country (HIPC) Initiative. Retrieved from http://www.worldbank.org/en/topic/debt/brief/hipc

[4] Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Ethiopia, Ghana, Sierra Leone and Zambia.

[5] Congo Republic, Eritrea, Gambia, Mozambique, São Tomé and Príncipe, South Sudan and Zimbabwe.

International Development Association (IDA), African Development Bank (AfDB), and IMF, with a hundred percent cancellation from the Paris Club[6].

The case of Mozambique is slightly different. Mozambique is one of the biggest gas exporters in the Sub-Saharan region. As of end-2017, the country was classified as "in distress" meanly because of unbridled indebtedness of oil-stated-owned enterprises following new oil and gas discoveries, coupled with the downward path of commodities prices and depreciation of metical in 2014-16. The amount of undisclosed external commercial loans reached the US $1.4 billion at this period. Mozambique Tuna Company (EMATUM), the state tuna-fishing company, took out a critical loan of US $850 million in 2013, or approximately 5 percent of the country's current GDP. This experience was the country's first international financial market experience after benefiting from the HPIC initiative in 2001, which led to the first significant debt scandal two years later. Some hidden clauses were revealed and have shown that the country took the opportunity to acquire patrol boats to protect their offshore hydrocarbons exploration platforms in the North of the country. After the scandal, the country's foreign partners reacted by temporally suspending their financial assistance to the country. As a result, Mozambican public sector external debt reached 104% in 2016 (IMF, 2018). In April 2016, EMATUM bondholders agreed with the government for a deferment with forbearance to postpone the outstanding on a particular payment in 2023 and maintain debt services only. This refinancing agreement has been entered based on future gas revenues. However, two other commercial loans were also contracted by state-owned companies Proindicus and MAM (Mozambique Asset Management), in 2016. Mozambican outstanding commercial debt was US $592 million at the end of 2017.[7] The fiscal deficit reached 7.6 percent in 2016. It will deteriorate further by 2023 because of huge investments for the construction of processing facilities for Liquefied Natural Gas and the payment of EMATUM debt. Therefore, the risk remains for Mozambique.

These recent examples shed light on the crucial issue of debt sustainability in sub-Saharan African resource-rich countries. For instance, it was the case of Ghana, for which oil quickly became the second-largest earner after gold and before cocoa in 2013, then led the country to a high-level risk of external debt distress. Given these alarming cases, we provide empirical evidence that discovering giant oil fields significantly increases the risk of

[6] For more information about Chad's debt burden see IMF 2017 & 2018, Debt Sustainability Analysis of Chad.
[7] Ibid

debt distress based on novel discoveries database. We show that this is especially true for undiversified economies. Future revenues open new borrowing opportunities, and hydrocarbons state-owned enterprises often rush to the deal without a deeper analysis.

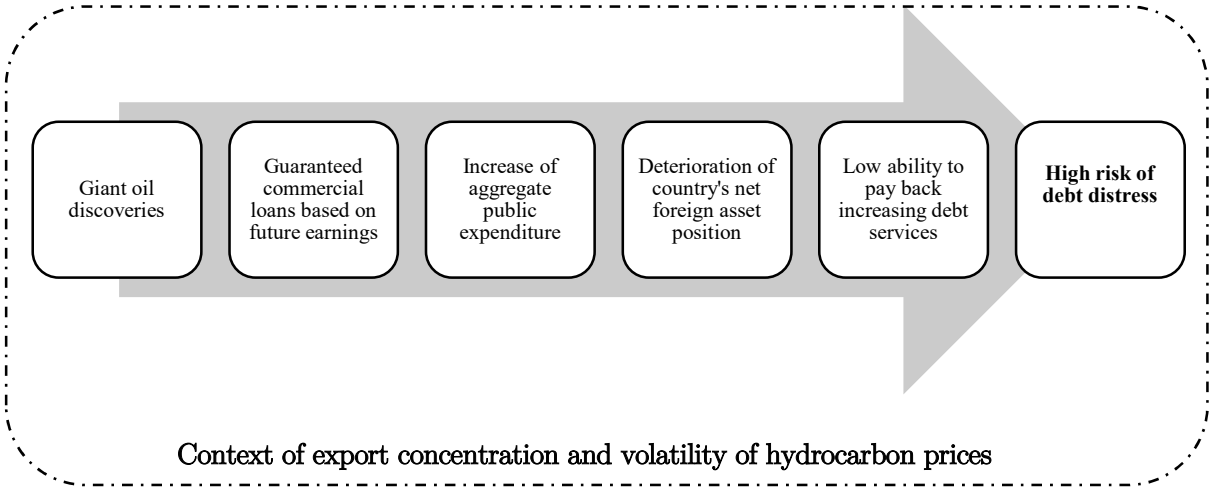
Our analysis is unique in two broad aspects: we focus on countries' level diversification and the study of specific transmission channels after the discovery. Regarding the latter aspect, we show that governments respond to the oil discovery by raising public spending in undiversified economies. On the contrary, governments do not launch unsustainable investments in diversified economies since they already have other sources of revenues and a stock of foreign currency reserves. Instead, it is the private sector that takes advantage of the wealth by increasing their investments.

To the best of our knowledge, this is the first paper that focuses on the effect of giant oil discoveries[8] on the debt burden in Sub-Saharan Africa. Mansoorian (1991) has addressed the question of excessive borrowing in resource-rich countries by a theoretical model. He found that debt incurred after discovery is mainly used for consumption and thus leads to an integrational problem because the current generation consumes the resources of future generations. Although the economic theory has focused on the side effects of natural resources in general, the interaction between giant oil discovery and debt distress gave countries' level of diversification has not yet been explored until now. Tsui (2011) and Arezki, Ramey, & Sheng (2017) put forward this new measure of resource endowment, but they focus on other macroeconomic challenges. Arezki, Ramey, & Sheng (2017) show that consumption and investment jump as soon as the news arrives. Thus, we assume that countries used debt to bridge the gap between current expenditures and future cash flows in less diversified economies.

On the contrary, when oil revenues are lower than anticipated, due to commodity prices swings, for example, diversified economies would more easily use non-resource sector revenues to set up countercyclical fiscal policies. Diversification acts as a buffer against debt distress. Figure 1 shows major steps leading to debt distress, after a giant resource discovery.

[8] Hereafter, we will refer to oil and gas discovery by oil discovery for seek of simplicity.

Figure 7: Major steps from giant oil discoveries to debt distress



Source: authors

To address the relationship between giant hydrocarbons discoveries and debt distress, we gradually test empirically four assumptions:

A1: Announce of giant oil discoveries raises the probability of debt distress in subsequent years

A2: Debt distress is more likely in less diversified economies

A3: After the discovery, government expenditures rose much faster in concentrated economies rather than in diversified economies

A4: Only diversified economies can attract more FDI and private investment due to their low risk of default.

The remainder of this paper is organized as follows. This paper begins with a short review of the literature regarding the effects of resource wealth in developing countries. In the third section, we show some stylized facts and statistics that comprehensively describe our argument on the growing issue of debt burden in the sub-Saharan region. We present our empirical strategy in the fourth section before discussing the results and taking stock of our hypothesis in the fifth section. The robustness of findings are tested in the sixth section, and the last section concludes with some policies implications for resource-rich developing countries to bypass the debt trap.

2. Related literature

Since empirical studies of Sachs & Warner (1995, 1999, 2001), natural resource discoveries have been linked to economic growth concerns and other macroeconomics aggregates. Instead of being a blessing, natural resources wealth has been associated with a curse, giving the paradox of increasing commodity dependence and low economic growth in developing countries. This is due to several factors such as bad institutions (Ross 2001, Mehlum et al. 2006), procyclicality of capital flows and fiscal policy, and volatility of commodity prices (Van Der Ploeg Poelhekke, 2009, 2010; Frankel, 2010). Yet, to this day, there is no consensus about the impact of discoveries on the economy.

We took advantage of this novel database by looking at the effect of giant oil discoveries on debt distress in the Sub-Saharan region. The debt burden is undoubtedly a crucial issue for these countries, given that most of them were eligible to the Heavily Indebted Poor Countries (HIPC). Since the keystone Theory of Keynes (1936), the economic literature closely looked at the relation between the three main economic aggregates: revenue, consumption, and saving. Countless studies have followed this work, showing that consumption expenditure is a function of the current income and future wealth. Friedman (1957) introduces the permanent income hypothesis (PIH), which predicts that expected long-term revenues are integrated into current consumption behavior. In doing so, Harberger (1985) points out the case of Mexico and Venezuela, which mortgaged their future oil revenues to finance current projects, leading to an increase in public spending instead of investing in long-term projects. In this context, Sachs (1989) has shown that developing countries have reached unsustainable debt levels to finance current consumption leaving aside investment. Buffie & Krause (1989) confirmed it by the case study on Mexico. Mansoorian (1991) emphasized this "intergenerational problem" with a theoretical model, stating that natural resource-rich countries borrowed extensively after their natural resource discoveries because of the lack of savings. Swings in the real exchange rate and their effects on the manufacturing sector. As far as we can go back in the literature, Manzano and Rigobon (2001) was the first study that empirically addressed the issue of the debt overhang problem in resource-rich countries. The paper's main goal was to propose solutions to econometric issues identified in the keystone work of Sachs and Warner (1995). The authors include the debt to GDP ratio into GDP growth regression to catch the fact that high commodity

prices relax credit constraints to the financial market. They found that the negative effect of non-agricultural exportations on growth does not remain.

Some authors have driven the further development of this, using a theoretical model. For example, Berg et al. (2013) use a dynamic stochastic general equilibrium (DSGE) model to analyze sovereign wealth funds to solve the sustainable investment path approach in resource-rich countries that face credit constraints and low tax revenues. In the same line, Melina, Yang, & Zanna (2016) proposed the Debt, Investment, Growth, and Natural Resources (DIGNAR) model and show that setting up a sovereign wealth fund and delinked investment regarding resource revenues can lead to macroeconomic stability and lower debt burden.

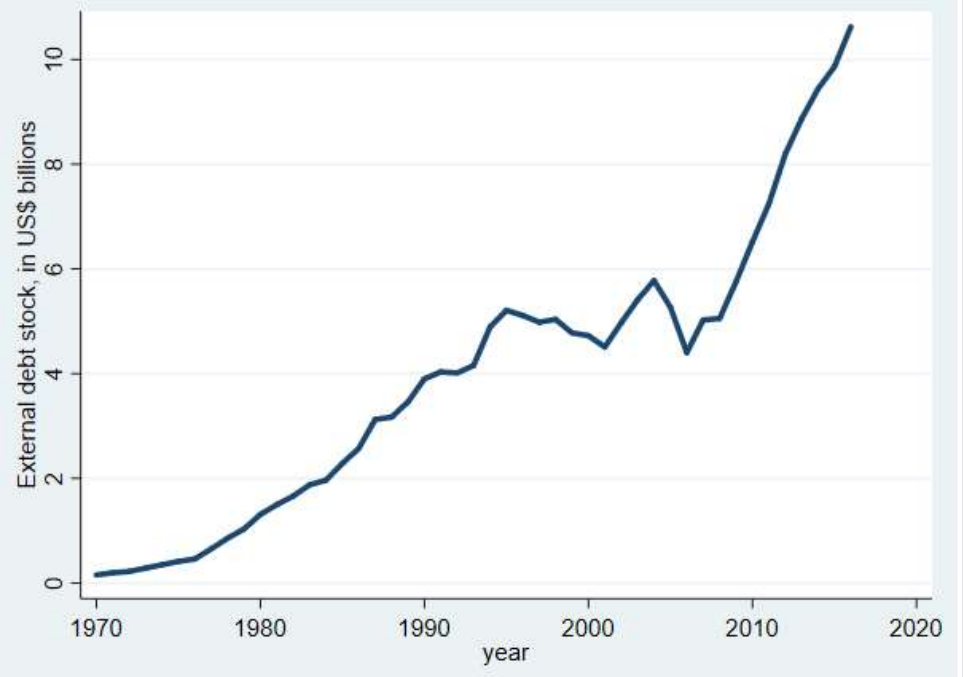
There seems to be a consensus that countries with relatively essential sources of revenues by saving, or as we propose in this paper, can maintain a sustainable level of sovereign debt by diversifying their economy.

To date, there are no empirical studies that investigate this issue. Several questions regarding the effect of diversification as a buffer against unsustainable indebtedness remain to be addressed. This paper tries to fill the gap. We go a step further on the existing literature. We argue that giant oil discoveries lead to significant sector-specific investments that can quickly lead to debt distress, especially in undiversified economies.

3. Stylized facts and descriptive statistics

This section highlights insights from past by historical graphs and descriptive statistics to bear out assumptions described in the introduction. Before moving forward on this section, we propose looking at the region's debt trend since 1970. Figure 2 shows three subperiods, approximately from 1970-1995, 1996-2005, and 2006 – present. In the first stage, external debt growth was relatively slower, from less than 1 US$ billion to 5 billion in twenty-five years, which can correspond to macroeconomics challenges of the post-colonial period. During the second stage, sub-Saharan debt stock fluctuates between 4 and 5 US$ billion temporary period of lull due to the mix of debt reductions programs and structural adjustment programs. Finally, the last stage deserves more attention since debt stock has risen from 5 billion to more than 10 US$ billion just in a decade. This reflects two elements: the growing access of developing countries to commercial loans and massive oil discoveries, which has given countries reason to increase their indebtedness.

Figure 8: Evolution of sub-Saharan external debt stock, in US$ billions, between 1970-2016

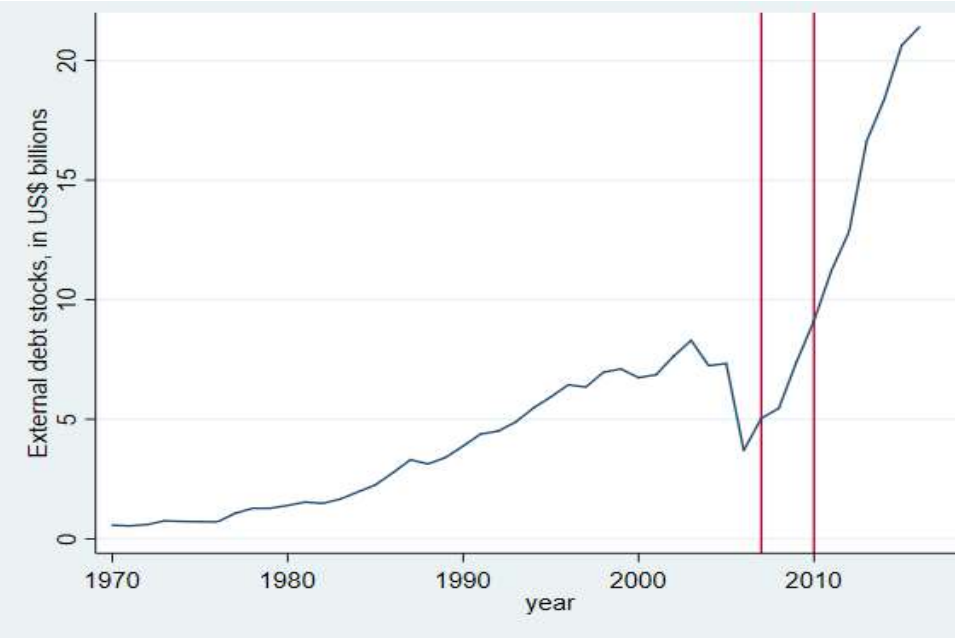


Source: IMF, Historical Public Debt Database

3.1. Debt trends in Sub-Saharan Africa: oil discoveries matter

These case studies give more credit to what we mentioned in the introduction and in the previous paragraph. It is striking how Ghana, Ethiopia, and Mozambique's debt path changed during the giant field discovering period. Countries launched prominent spending plans financed principally by contracting international loans. Ghana issued its first Eurobond in 2007, in the same year of its first oil discovery. Five US$ billion country hit a record level of 20 US$ billion in 2015. Years after, other oil-rich countries have followed the Ghanaian example.

Figure 9 : Ghana case study: Evolution external debt in US$ billions, and years of major oil discoveries (2007 and 2010)

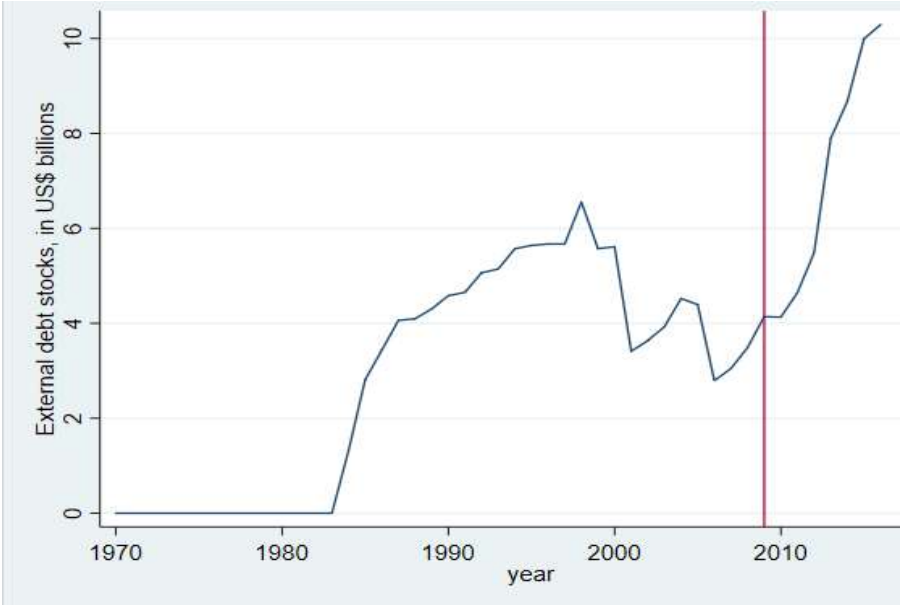


Source: IMF, Historical Public Debt Database

Figure 10: Evolution external debt of Ethiopia in US$ billions, and years of major oil discoveries

Source: IMF

Figure 11: Evolution external debt of Mozambique in US$ billions, and years of major oil discoveries

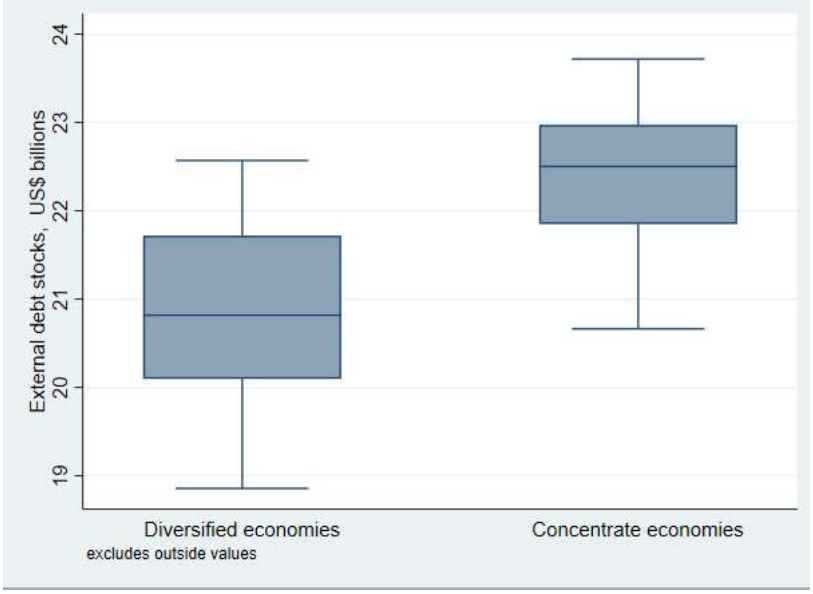


Source: IMF, Historical Public Debt Database

3.2. The impact of export diversification

In this subsection, we seek to highlight the assumption that exports diversification could allow countries to accumulate resource revenues to maintain a sustainable indebtedness level. As we see in figure 15, since 1970, undiversified economies have reached higher external debt levels than diversified economies, as mentioned in assumption 2.

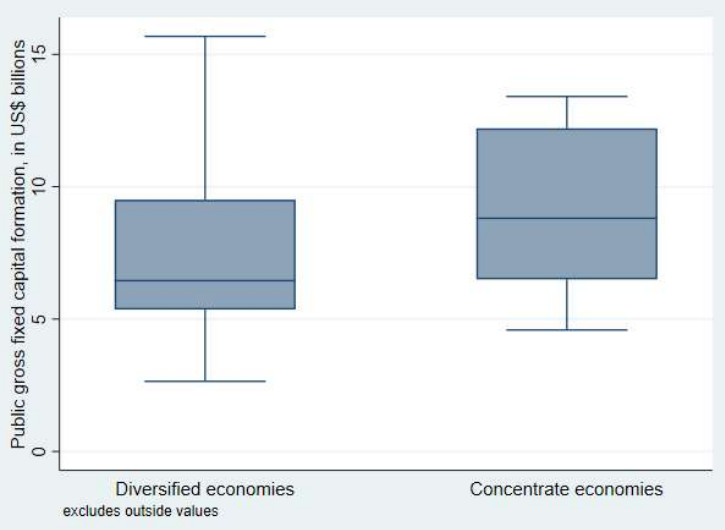
Figure 12: Comparison of debt stocks between diversified and concentrated economies



Source: IMF, Historical Public Debt Database

In the same line of thought, we analyze the difference in investment path between concentrated and diversified economies, as we assumed in assumption 3. Again, the results are similar regarding the preceding; the more diversified the country is, the more investment are sustainable.

Figure 13: Comparison of public investment between diversified and concentrated economies



Source: IMF, Investment and Capital Stock database

3.3. Summary statistics

Table 2 provides a synthetic summary of differences in the distribution of our main variables regarding whether a country has already discovered oil fields or not. It also compares diversification levels between countries that have already been declared in debt distress and others since 1970. It shows that external debt burden and public investment are more critical in discovering oil fields countries. Countries with the most negligible reserves have approximately a quarter of the mean debt stock of those with the largest ones. The first group is also more diversified. Moreover, the last two lines show that countries that have already experienced a debt crisis are also most concentrated.

Table 1: Differences in main variables, by discoveries and crisis

Variables		Number of countries	Mean	Standard deviation	Min	Q1	Q2	Q3	Max
External debt	discovery=0	30	2.76	6.03	0.15	0.54	1.10	2.71	33.57

	discovery=1	12	6.9	5.47	0.94	3.11	5.94	9.55	20.01
Gross fixed capital formation	discovery=0	29	8.50	3.58	2.65	6.23	7.38	10.78	17.22
	discovery=1	13	10.42	10.39	3.29	5.97	7.40	9.67	43.33
Exports diversification index	discovery=0	31	3.96	1.16	1.03	3.31	4.46	4.70	5.45
	discovery=1	14	4.18	1.36	1.19	3.59	4.18	5.27	5.86
Exports diversification index	Sovereign debt crisis = 0	6	1.6	0.42	1.03	1.19	1.71	1.77	2.18
	Sovereign debt crisis = 1	39	4.4	0.78	2.04	4	4.56	4.96	5.86

Source: Authors' calculations based on IMF'database

4. Methodology and data description

We first present the dataset, with a focus on the definition of crisis and giant oil discoveries. Next, we specify the methodology used.

4.1. Data

For this study, we analyzed the data collected from various sources for 39 countries from 1971 to 2010.

External debt crisis: our crisis variable is an updated version of the external crisis variable of Kraay & Nehru (2006). We have identified debt crisis episodes by three criteria

(1) **Amount of interests and principal arrears:** country reports arrears above 5 percent of debt outstanding.

(2) **Paris rescheduling or debt relief:** country receives Paris-club debt rescheduling or debt reduction. Only the year and the two subsequent years were considered.

(3) **IMF support on balance of payment**: Country has an agreement with IMF for support on the balance of payment, with an amount greater than 100 percent of its quota. This criterion was an updated version from Kraay & Nehru (2006), which proposed 50 percent. The new threshold of 100 percent is more in line with amounts of IMF support on the balance of payment nowadays. It was also used in Baldacci (2011) and Medas et al. (2018). In the following lines, we provide regressions that show that varying the threshold of 100 percent does not change results.

Giant oil discoveries and reserves:

In this study, we consider both giant oil and gas discoveries. For the sake of simplicity, we referred to them as "giant oil discoveries." The size of its reserves identifies a giant discovery. We follow Arezki et. al, (2017), and set the minimum threshold at 500 barrels of ultimately recoverable oil equivalent. It is a binary variable equal to 1 if country i experienced a new shock at time t, and 0 otherwise.

We use alternatively a dummy of giant oil discovery and the size of oil endowment (reserves) approximated by geologists. For the latter we follow, authors like Tsui (2011), who exploited variation of oil endowment assuming that geological characteristics is exogenous.

4.1.1. Endogeneity concerns of giant oil discoveries and reserves:

Our variables of interest can be considered as endogenous for two main reasons:

- Exploration costs are reduced for technologies-owner countries, which has a low probability of falling in debt distress.
- Sequential discoveries lead to a higher probability of new discoveries, which caught countries in a debt trap as governments overestimate underground wealth.

We address these issues through empirical methodology and regressions on a sub-sample of countries that have not experienced sequential discoveries. In the same vein, we introduced one period lagged controls to reduce the effects of potential endogeneity issues.

Other explanatory variables:

We introduced two set of variables inspired by existing literature on sovereign default: economic controls that reflect countries' fiscal and monetary performance and institutional controls for political indicators.

Economic variables

The subgroup of economic variables includes GDP per capita, GDP growth, Debt to GDP, Inflation, and Trade Openness. The specification of our model is partially based on the equation of debt evolution $b_t - b_{t-1} \equiv$ (i-n)$b_{t-1} + d_t$, where b_t is debt ratio at time t, i the real interest rate, n the nominal growth rate, and d_t the primary deficit. A high country's GDP growth reduces the real value of debt. (Bénassy-Quéré et al., 2017) . Debt to GDP capture debt burden as in Kraay & Nehru, (2006). Inflation allows to capture macroeconomic

instability, since monetary authorities can use this instrument to reduce the real value of debt. Trade Openness controls the effect of market orientation on oil discoveries, following recommendations of Arezki, van der Ploeg, & Toscani (2019).

Institutional controls

The rubric of institutional controls consists of the Conflict intensity index[9] (from Uppsala Conflict Data Program), CPIA mean, policy uncertainty index, and Democracy index. The seminal work of Reinhart & Rogoff (2014) shows that sovereign defaults are consecutive to conflict since the 19th century. CPIA mean is an arithmetic mean of the CPIA ratings to control for the quality of public policies[10]. Policy uncertainty index captures countries' economic and policy uncertainty. Adding the Democracy index is consistent with Arezki & Brückner's (2012) conclusions that find heterogeneities between democracies and autocracies regarding the impact of commodities windfalls on external debt.

4.2. Methodology

We address this issue using a random-effect complementary log-log model, as our dependent variable is a binary outcome. The complementary log-log model is augmented by Mundlak's (1978) correction to tackle endogeneity issues mentioned above. We refer to our model as the RE-Mundlak model as in Caballero (2016). The complementary log-log model is an alternative to most common binary models' (logit and probit) which use symmetric distributions. The correction consists of integrating into the regression means of controls variables that we suspected to be endogenous. Wooldridge (2018) shows that this correction can be generalized to nonlinear models. RE-Mundlak especially allows us to use the information on countries that have not experienced debt distress during the period. It belongs to binomial family models as traditional binary models but uses Gumbel distribution which relates to extreme values theory. Our assumption behind this choice is that debt distress episodes are not identically distributed over 1970-2012. This contrasts with what has already been done in the literature. For example, Manasse, Roubini, & Schimmelpfennig (2003) used a robust logit approach

[9] It denotes two levels of conflicts (1-Minor: when in a calendar year, there are least 25 but less than 1000 battle-related deaths and 2- War: when there are at least 1000 battle-related deaths in the same period)

[10] Country Policy and Institutional Assessment (CPIA) is ranged from 1 (lowest quality) to 6 (highest quality)

to check determinants of an external debt crisis in emerging countries. Kraay & Nehru (2006) followed this work, which initially introduced the concept of "debt distress" based on three main characteristics. First, their empirical methodology relies on a parsimonious probit model instead.

Conversely, Caballero (2016) proposed RE-Mundlak to assess the impact of capital inflows bonanzas as a determinant of the banking crisis and Eberhardt & Presbitero (2018) to assess the effects of commodity prices swings on the banking crisis. All these binary models follow this general form:

$$P(y = 1|x) = \phi(X\beta) \equiv \pi(x) \quad \text{(a)}$$

With $\pi(x)$ a function of X only through the index $x_{kit}\beta_k = \beta_1 + \beta_2 x_{2it} + \ldots + \beta_K x_{NTK}$ and $\phi(z)$ the continuous cumulative distribution function. The subscript $i = 1,\ldots,N$ stands for country dimension, $t = 1,\ldots,T$ for time dimension, and k = 1, ..., K for explanatory variables described above. The left-hand-side of the equation (a) can be specified as

$$P(y_{it} \neq 0|X_{it}) = P(x_{it}\beta + \nu_i) \quad \text{(b)}$$

Where ν_i are identically independently distributed random effects assuming normal distribution $N(0, \sigma_\nu^2)$. The variance-components of equation (b) is $y_{it} \neq 0 \Leftrightarrow x_{it}\beta + \nu_i + \varepsilon_{it}$ and ε_{it} follows a Gumbel distribution. The response curve of $\phi(z)$ belongs to the interval [0,1] as for probit and logit models for all z in $\mathbb{R}$. Y is the dependent variable[11] which takes 1 during a debt distress episode in country i, at time t, and zero otherwise. $\phi(.)$ is non-symmetric on his restricted response interval [0,1]. Equation (a) can be broken down as:

$$P(z) = 1 - \exp\{-\exp(z)\} \quad \text{(c)}$$

On the contrary of a normal distribution or logit distribution that are symmetric, equation (b) means that the evolution of π(x) is not the same around extreme values: 0 or 1. This property makes the Complementary log-log model the right choice when an event is rare.

In the robustness section, we present alternative regressions methods instead of the complementary log-log model. The results remain.

[11] The latent variable formulation of y can be written as follow: $y^* = x\beta + e$, with y=1 if $y^* > 0$.

5. Results

In this section, we present coefficients that give intuition on the direction of the relation and common marginal effects to assess the magnitude of discoveries and size of reserves effects on probability for sub-Saharan countries to be in debt distress. For all regressions, we present Wald test results for the mean of all covariates included in the model. It assesses whether within or random models are statically different Caballero (2016). When p-values associated to the test are below conventional thresholds, RE-Mundlack or FE model gives efficient results. This is the case for all the tables presented below. Thus, we prefer the first model as some of our institutional controls change very little during the period.

To add to that, we present statistics that measure the area under the ROC curve to appreciate the "accuracy" of the model. The prediction is "good" if the AUROC statistic is close to one. This implies that the model classifies correctly the group of countries that experienced debt distress episodes (*treated group*) and those which did not experienced it. The AUROC test was used to study financial crisis by Jordà, Schularick, & Taylor (2011), Schularick & Taylor (2012), and Eberhardt & Presbitero (2018) for banking crisis literature and by Catão & Milesi-Ferretti (2014) for external debt literature. Again, for all tables, the AUROC stats are above 0.70, which means that the model can classify observations correctly, hence have good prediction power.

5.1. Baseline results

In this section, we turn on the results of our baseline specification after estimating the RE-Mundlack model[12]. Table 1 shows that countries that have discovered giant oil fields the year before or two years ago have a positive and significant probability of experiencing debt distress. Columns 1 to 3 show that giant oil discoveries raise the likelihood of debt distress by an average of 15 percentage points. However, this effect lasts only for two years; the third-year coefficient is not significant. Finally, in the fourth and sixth columns, we present the impact of the size of reserves; these results are in line with those on discoveries.

The coefficients of other predictors are consistent with the literature on the debt crisis. Among economic controls, trade openness, GDP per capita, debt burden, and inflation are key predictors of debt distress; only

[12] Marginal effects of are reported under standard errors for variables indicating giant discoveries.

GDP growth is not. Debt burden is associated with a high probability of debt distress Kraay & Nehru (2006b) and Catão & Milesi-Ferretti (2014). High inflation also plays a positive role in debt distress, especially when the exchange rate does not reflect its real value. The present value of foreign debt in local currency increases if the exchange rate depreciates faster than prices (Wyplosz 2005). GDP growth that measures economic shocks is not significant in our specification.

The second set of variables include four indicators of policies and institutions. The conflict intensity index, which controls the intensity of conflicts, and the policy uncertainty index are significant and positively related to debt distress. However, the policy uncertainty index is significant only in the first year, which suggests that uncertainty does not affect after the year of announcement.

Table 1: Baseline results

Random complementary log-log model - Mundlack						
Debt distress [t]	(1)	(2)	(3)	(4)	(5)	(6)
Discovery [t-1]	**0.7432****					
	(0.353)					
	0.1512					
Discovery [t-2]		**0.7639****				
		(0.344)				
		0.1562				
Discovery [t-3]			**0.4330**			
			(0.350)			
			0.0887			
Reserves [t-1]				**0.1000****		
				(0.051)		
				0.0204		
Reserves [t-2]					**0.1102****	
					(0.050)	
					0.0225	
Reserves [t-3]						**0.0663**
						(0.050)
						0.0136
Log of GDP per capita [t-1]	-0.7074**	-0.7031***	-0.7254***	-0.7093**	-0.7062***	-0.7260***
	(0.278)	(0.271)	(0.266)	(0.278)	(0.271)	(0.266)
Log of GDP growth [t-1]	-0.0114	-0.0108	-0.0110	-0.0113	-0.0107	-0.0111
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Debt to GDP [t-1]	0.0071***	0.0072***	0.0070***	0.0070***	0.0072***	0.0070***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation [t-1]	0.0186***	0.0180***	0.0174***	0.0186***	0.0180***	0.0174***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Trade openess [t-1]	-0.6676***	-0.7305***	-0.7622***	-0.6685***	-0.7327***	-0.7648***
	(0.217)	(0.217)	(0.216)	(0.217)	(0.217)	(0.217)
Conflict intensity index [t-1]	0.2554**	0.2756**	0.2618**	0.2542**	0.2761**	0.2630**
	(0.116)	(0.113)	(0.110)	(0.116)	(0.113)	(0.110)
cpia mean [t-1]	-3.0469	-3.2251	-3.2960	-3.0578	-3.2346	-3.3073
	(2.254)	(2.226)	(2.184)	(2.243)	(2.215)	(2.175)
policy uncertainty index [t-1]	0.8430***	0.3970	0.1226	0.8451***	0.3955	0.1219
	(0.266)	(0.276)	(0.281)	(0.266)	(0.276)	(0.281)
Democracy [t-1]	-0.0163	-0.0163	-0.0192*	-0.0162	-0.0163	-0.0192*
	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)
Constant	-438.2232	-433.9296	-439.4937	-433.2317	-429.7426	-436.5898
	(346.548)	(342.297)	(336.024)	(346.271)	(342.232)	(336.203)
Observations	1,297	1,311	1,325	1,297	1,311	1,325
Number of id	39	39	39	39	39	39

Log likelihood	-633.3	-641.6	-646.8	-633.5	-641.5	-646.7
Wald chi2	14.07	14	14.31	14.18	14.13	14.39
Wald test pvalue	0.0799	0.0817	0.0739	0.0771	0.0785	0.0722
Rho(LR)	0.297	0.291	0.282	0.296	0.291	0.282
P-value(Rho)	0	0	0	0	0	0
AUROC	0.741	0.741	0.743	0.740	0.740	0.743
seAUROC	0.00960	0.00951	0.00940	0.00961	0.00952	0.00941

Notes: Dependent variable is a dummy identifying debt distress. It is constructed following Kraay and Nerhu's (2006) definition of debt distress episode. We have updated this definition by increasing arrears from 50 to 100 percent of the IMF quota to consider the macroeconomic characteristics of countries better. Three categories of explanatory variables were included in the model: [1] six variables of interest - three lagged oil giant discoveries dummies, and three lagged measures of oil reserves, [2] economic and [3] institutional controls. Regressions are obtained using Random complementary log-log model estimator. In all estimations, we apply Mundlack's correction by including the country mean of all covariates. The figures reported for the Wald test are the joint significance of all means included. AUROC statistics refer to Receiver Operating Characteristic (ROC) curve analysis.
Marginal effects are reported for six first variables of interest. Standard errors in parentheses:
* Significant at the 10 percent level.
** Significant at the 5 percent level.
***Significant at the 1 percent level.

5.2. Removing discoveries in the past three years and non-sequential discoveries

Here, we present two regressions considering endogeneity concerns described in section II. In columns 1-3, we only keep discoveries not preceded by discoveries in the previous three years. The other columns show results excluding sequential discoveries[13]. Baseline's results remain for interest and control variables. Interestingly, we can see in the column that the effect's magnitude rises to 19 percent, suggesting that results were previously underestimated.

Table 2: Baseline specification without discoveries in past three years and non-sequential discoveries

Random complementary log-log model - Mundlack						
	(1)	(2)	(3)	(4)	(5)	(6)
Debt distress [t]	Without discoveries in the last three years			Without sequential discoveries		
Discovery [t-1]	0.8772**			0.8450**		
	(0.441)			(0.390)		
	0.178			0.1681		
Discovery [t-2]		0.7424*			0.7615**	
		(0.419)			(0.378)	
		0.1515			0.1539	
Discovery [t-3]			0.4128			0.0957
			(0.425)			(0.413)

[13] We also examine how the effect of discoveries on countries with low oil initial reserves (first quartile of oil reserves distribution before 2000). Results do not change.

			0.0844			0.0205
Log of GDP per capita [t-1]	-0.7125**	-0.7145***	-0.7270***	-0.7153**	-0.7167***	-0.7224***
	(0.279)	(0.272)	(0.266)	(0.280)	(0.273)	(0.267)
Log of GDP growth [t-1]	-0.0115	-0.0107	-0.0109	-0.0115	-0.0107	-0.0108
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Debt to GDP [t-1]	0.0070***	0.0071***	0.0069***	0.0071***	0.0072***	0.0069***
	(0.001)	(0.001)	(0.001)	(0.001)	-0.001	(0.001)
Inflation [t-1]	0.0184***	0.0178***	0.0173***	0.0185***	0.0179***	0.0174***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log of trade [t-1]	-0.6477***	-0.7102***	-0.7533***	-0.6531***	-0.7117***	-0.7408***
	(0.216)	(0.216)	(0.216)	(0.217)	(0.216)	(0.215)
Conflict intensity index [t-1]	0.2435**	0.2628**	0.2562**	0.2485**	0.2676**	0.2601**
	(0.115)	(0.112)	(0.110)	(0.115)	(0.113)	(0.110)
cpia mean [t-1]	-2.7736	-2.9176	-2.9697	-2.9093	-3.0711	-3.1502
	(2.398)	(2.360)	(2.314)	(2.310)	(2.275)	(2.224)
policy uncertainty index [t-1]	0.8594***	0.4084	0.1302	0.8518***	0.4098	0.1285
	(0.266)	(0.276)	(0.281)	(0.266)	(0.275)	(0.281)
Democracy	-0.0160	-0.0158	-0.0189*	-0.0162	-0.0163	-0.0192*
	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)
Constant	-412.1461	-400.9537	-404.1808	-442.4052	-433.6524	-435.0943
	(358.515)	(353.009)	(346.268)	(347.844)	(342.719)	(335.289)
Observations	1,297	1,311	1,325	1,297	1,311	1,325
Number of id	39	39	39	39	39	39
Log likelihood	-633.6	-642.5	-647.1	-633.2	-642	-647.5
Wald chi2	13.73	13.83	14.11	13.59	13.68	14.02
Wald test pvalue	0.0891	0.0863	0.0789	0.0932	0.0906	0.0813
Rho(LR)	0.301	0.294	0.284	0.299	0.292	0.282
P-value(Rho)	0	0	0	0	0	0
AUROC	0.741	0.741	0.744	0.743	0.743	0.747
seAUROC	0.00966	0.00955	0.00944	0.00961	0.00950	0.00938

Notes: Dependent variable is a dummy identifying debt distress. It is constructed following Kraay and Nerhu (2006) definition of debt distress episode. We have updated this definition by increasing arrears from 50 to 100 percent of IMF quota to better consider the macroeconomic characteristics of countries. Three categories of explanatory variables were included in the model: [1] three variables of interest - three lagged oil giant discoveries, dummies, here we remove countries with sequential discoveries or those with discoveries in the last three years, [2] economic and [3] institutional controls. Regressions are obtained using Random complementary log log model estimator. In all estimations, we apply Mundlack's correction by including the country mean of all covariates. The figures reported for the Wald test are the joint significance of all means included. AUROC statistics refer to Receiver Operating Characteristic (ROC) curve analysis.

Marginal effects are reported for six first variables of interest. Standard errors in parentheses:

* Significant at the 10 percent level.

** Significant at the 5 percent level.

***Significant at the 1 percent level.

5.3. Checking for omitted variables

To improve our identification strategy, we control for a wide range of explanatory variables in addition to our baseline specification. Table 3 shows the results[14]. The positive impact of discoveries on experiencing debt distress remains, and results confirm the downward bias, as marginal effect rose to 20 percent in column 7. Only two variables are significant. We focus on the result of diversification that matters for the last three assumptions. It is a Theil's entropy index (Theil, 1972), computed following the methodology developed in Cadot et al. (2011). It is an aggregation of extensive and intensive margins and is considered in the literature as more stable than the Herfindahl-Hirschman Index (Hirschman, 1964). It can be viewed as both a concentration/diversification index because of its interpretation. Indeed, the index is ranged from lowest values (diversified economies) to highest values (concentrated economies).

The coefficient associated to the index in table 3 suggests that exports concentration has a significative and positive impact on debt distress. This result is in line with assumption two.

[14] Definitions of all the variables included are shown in appendix.

Table 3 : Adding other explanatory variables

Dependant variable : Debt distress [t]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Discovery [t-1]	**0.8296****	**0.7739****	**0.8029****	**0.7984****	**0.7880****	**0.7812****	**1.1248****	**0.7872****	**0.7928****	**0.7395****
	(0.347)	**(0.354)**	**(0.350)**	**(0.348)**	**(0.347)**	**(0.348)**	**(0.480)**	**(0.350)**	**(0.351)**	**(0.366)**
	0.1688	**0.1566**	**0.1596**	**0.1676**	**0.1641**	**0.1585**	**0.2023**	**0.1591**	**0.1599**	**0.1508**
Distress historic [t-1]	0.0209									
Diversification [t-1]		0.2953***								
Term of trade [t-1]			-0.0953							
[t-1]				-0.0001						
US bond yield [t-1]					0.0894***					
World GDP Growth [t-1]						-0.0371				
Real interest rate [t-1]							-0.0022			
Coup d'Etat [t-1]								-0.4174		
Gvt crisis [t-1]									-0.0695	
Broad money [t-1]										-0.0140
Economic controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Institutional controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1,297	1,297	1,206	1,278	1,278	1,297	658	1,242	1,247	1,233
Number of id	39	39	39	38	38	39	35	39	39	39
Log likelihood	-631.1	-625	-582.4	-629.9	-619	-633	-284.4	-607.4	-609.1	-594.3
Wald chi2	7.706	16.03	12.27	13.14	13.67	14.17	17.13	11.62	12.55	16
Wald test pvalue	0.463	0.0420	0.140	0.107	0.0908	0.0775	0.0288	0.169	0.128	0.0424
Rho(LR)	0.278	0.293	0.321	0.275	0.266	0.301	0.312	0.297	0.295	0.308
P-value(Rho)	0	0	0	0	0	0	6.49e-09	0	0	0
AUROC	0.775	0.748	0.734	0.746	0.752	0.750	0.783	0.735	0.733	0.753
seAUROC	0.00909	0.00951	0.00984	0.00957	0.00953	0.00945	0.0126	0.00986	0.00985	0.00963

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; Notes: To reduce the size of the table, we did not report standard errors for controls

6. Transmissions channels

At this point, we have tested the first two assumptions and concluded to a significant and positive impact of discoveries and exports concentration on debt distress. The next step is to focus on transmission channels. Finally, we have tested three direct consequences of oil discoveries in resource-rich sub-Saharan countries:

- Public investment to finance development costs.
- Foreign direct investment in countries where the tax system is an incentive.
- Private investment, for countries where the private sector is developed enough to finance expected development or operating expenditure.

Hence, we have run regressions on public investment, foreign direct investment, and private investment respectively. Tables 4-6 show that discoveries and reserves positively and significantly impact these financial flows during the two subsequent years. However, we choose to desegregate this effect depending on countries' level of concentration to understand better heterogeneities associated to these results.

6.1. Public investment

Table 4: Testing effect of discoveries on investments

RE model - Mundlack						
Gross fixed capital formation	(1)	(2)	(3)	(4)	(5)	(6)
Discovery [t-1]	**2.8645****					
	(1.328)					
Discovery [t-2]		**2.9312****				
		(1.368)				
Discovery [t-3]			**0.5167**			
			(1.957)			
Reserves [t-1]				**0.4087****		
				(0.188)		
Reserves [t-2]					**0.4246****	
					(0.193)	
Reserves [t-3]						**0.1091**
						(0.270)
Log of GDP per capita [t-1]	-6.3810*	-6.3541*	-6.2654*	-6.3860*	-6.3590*	-6.2698*
	(3.788)	(3.732)	(3.663)	(3.789)	(3.731)	(3.663)
Log of GDP growth [t-1]	0.2020***	0.1980***	0.1984***	0.2020***	0.1984***	0.1984***
	(0.069)	(0.065)	(0.066)	(0.069)	(0.065)	(0.066)
Debt to GDP [t-1]	0.0001	0.0006	0.0001	0.0000	0.0006	0.0001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Inflation [t-1]	0.0014	0.0010	0.0005	0.0014	0.0010	0.0005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Log of trade [t-1]	6.1876***	6.4090***	6.6836***	6.1817***	6.3983***	6.6658***
	(1.524)	(1.593)	(1.683)	(1.525)	(1.590)	(1.676)
Conflict intensity index [t-1]	-0.1657	-0.2962	-0.3999	-0.1605	-0.2929	-0.3979
	(0.514)	(0.566)	(0.597)	(0.516)	(0.568)	(0.597)
cpia mean [t-1]	-20.3585***	-19.5542***	-19.2795***	-19.9909***	-19.2209***	-18.9768***
	(6.675)	(6.687)	(6.633)	(6.644)	(6.652)	(6.591)
policy uncertainty index [t-1]	1.3123	1.7445	2.0587	1.3046	1.7408	2.0540
	(1.155)	(1.229)	(1.314)	(1.152)	(1.228)	(1.310)
Democracy [t-1]	-0.2912***	-0.2920***	-0.2891***	-0.2910***	-0.2920***	-0.2890***
	(0.091)	(0.090)	(0.091)	(0.091)	(0.091)	(0.090)
Observations	980	1,007	1,034	980	1,007	1,034
Number of id	37	37	37	37	37	37
Year FE	YES	YES	YES	YES	YES	YES
Wald chi2	191.2	170.6	162.7	191.4	171.6	164.5
Wald test pvalue	0	0	0	0	0	0

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.4. Foreign Direct investment

Table 5: Testing effect of discoveries on FDI

RE model - Mundlack						
Foreign direct investment [t]	(1)	(2)	(3)	(4)	(5)	(6)
Discovery [t-1]	**5.3420****					
	(2.585)					
Discovery [t-2]		**6.8984***				
		(3.721)				
Discovery [t-3]			**4.7785**			
			(3.486)			
Reserves [t-1]				**0.8260****		
				(0.380)		
Reserves [t-2]					**1.0405***	
					(0.553)	
Reserves [t-3]						**0.7269**
						(0.517)
Log of GDP per capita [t-1]	-1.8854**	-1.9386**	-1.9675**	-1.8872**	-1.9409**	-1.9699**
	(0.897)	(0.953)	(0.983)	(0.896)	(0.951)	(0.980)
Log of GDP growth [t-1]	0.2515**	0.2396**	0.2430**	0.2519**	0.2402**	0.2430**
	(0.104)	(0.101)	(0.105)	(0.104)	(0.101)	(0.105)
Debt to GDP [t-1]	-0.0076	-0.0084	-0.0089	-0.0077	-0.0085	-0.0089
	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
Inflation [t-1]	-0.0007	0.0008**	0.0006	-0.0007	0.0008**	0.0006
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Log of trade [t-1]	2.4300**	2.7633***	3.0987***	2.4057**	2.7324***	3.0722***
	(0.977)	(1.018)	(1.046)	(0.971)	(1.006)	(1.035)
Conflict intensity index [t-1]	1.0993*	0.9580	0.9814	1.1227*	0.9651	0.9871
	(0.631)	(0.611)	(0.625)	(0.634)	(0.601)	(0.624)
cpia mean [t-1]	-7.7308*	-6.7444	-6.3296	-7.7705*	-6.7723	-6.3648
	(4.306)	(4.337)	(4.535)	(4.344)	(4.368)	(4.553)
policy uncertainty index [t-1]	2.1551**	2.5162**	2.6635***	2.1411**	2.5029**	2.6609***
	(0.904)	(1.014)	(1.004)	(0.898)	(1.004)	(1.001)
Democracy [t-1]	0.1101***	0.1092***	0.1134***	0.1097***	0.1088***	0.1131***
	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)	(0.043)
Observations	1,264	1,290	1,315	1,264	1,290	1,315
Number of id	39	39	39	39	39	39
Year FE	YES	YES	YES	YES	YES	YES
Wald chi2	58.85	56.98	45.98	58.57	56.28	45.99
Wald test pvalue	7.82e-10	1.82e-09	2.40e-07	8.90e-10	2.49e-09	2.39e-07

6.5. Private investment

Table 6: Testing effect of discoveries on Private investment

RE model - Mundlack						
Private Investment	(1)	(2)	(3)	(4)	(5)	(6)
Discovery [t-1]	**6.0433****					
	(2.919)					
Discovery [t-2]		**4.3339*****				
		(1.511)				
Discovery [t-3]			**0.8762**			
			(3.280)			
Reserves [t-1]				**0.8272****		
				(0.411)		
Reserves [t-2]					**0.5979*****	
					(0.207)	
Reserves [t-3]						**0.1876**
						(0.459)
Log of GDP per capita [t-1]	-3.8355**	-3.9472**	-4.0222**	-3.8429**	-3.9509**	-4.0299**
	(1.861)	(1.966)	(1.932)	(1.865)	(1.965)	(1.932)
Log of GDP growth [t-1]	0.2685***	0.2599***	0.2604***	0.2684***	0.2608***	0.2604***
	(0.079)	(0.076)	(0.083)	(0.079)	(0.077)	(0.083)
Debt to GDP [t-1]	0.0015	0.0015	0.0012	0.0013	0.0014	0.0013
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Inflation [t-1]	0.0195***	0.0189***	0.0184***	0.0194***	0.0190***	0.0184***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Log of trade [t-1]	8.8126***	9.2652***	9.5927***	8.8072***	9.2553***	9.5596***
	(2.094)	(2.180)	(2.289)	(2.103)	(2.183)	(2.291)
Conflict intensity index [t-1]	1.1291*	0.8895	0.8090	1.1309*	0.8909	0.8115
	(0.642)	(0.656)	(0.663)	(0.644)	(0.656)	(0.664)
Cpia mean [t-1]	-13.0689	-12.0974	-11.6348	-12.6866	-11.6343	-11.1057
	(9.043)	(9.201)	(9.558)	(9.056)	(9.238)	(9.612)
Policy uncertainty index [t-1]	2.3724	3.0734*	3.6286**	2.3668	3.0719*	3.6201**
	(1.542)	(1.623)	(1.660)	(1.549)	(1.625)	(1.660)
Democracy [t-1]	0.1270	0.1287	0.1410	0.1275	0.1288	0.1411
	(0.091)	(0.094)	(0.096)	(0.091)	(0.094)	(0.096)
Observations	980	1,007	1,034	980	1,007	1,034
Number of id	37	37	37	37	37	37
Year FE	YES	YES	YES	YES	YES	YES
Wald chi2	94.56	90.36	90.91	90.96	87.58	87.83
Wald test pvalue	0	0	0	0	0	0

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.6. Impact of exports diversification on debt sustainability issues in SSA countries

Following the previous results on diversification, we check for heterogeneities of the impact of discoveries on three transmission channels: public investment, foreign direct investment, and private investment. Table 7 show that there is a crowding-out effect of the public sector only in concentrated economies. In diversified ones, development and production costs are mainly financed by foreign investors via FDI and the private sector.

Table 7: Heterogeneity in the impact of discoveries on concentrated and diversified countries

	RE model - Mundlack					
	(1)	(2)	(3)	(4)	(5)	(6)
Dependant variables :	**Public investment**		**Pivate investment**		**FDI**	
	Concentrated economies	Diversified economies	Concentrated economies	Diversified economies	Concentrated economies	Diversified economies
Discovery [t-1]	**3.5762****	**-0.1165**	**5.2279**	**8.9681****	**4.1359**	**10.0359****
	(1.747)	**(1.297)**	**(4.021)**	**(3.664)**	**(2.614)**	**(4.527)**
Log of GDP per capita [t-1]	-10.0768***	3.7375*	-5.0104***	-0.5766	-3.2632***	0.4141
	(1.567)	(2.243)	(1.266)	(2.229)	(0.807)	(1.238)
Log of GDP growth [t-1]	0.2548***	0.0294	0.2998***	0.1661***	0.3127***	0.0701***
	(0.048)	(0.023)	(0.076)	(0.034)	(0.102)	(0.020)
Debt to GDP [t-1]	-0.0008	-0.0050	0.0040	-0.0052	-0.0091	-0.0046
	(0.005)	(0.004)	(0.011)	(0.013)	(0.015)	(0.007)
Inflation [t-1]	0.0007	0.0013	0.0202***	0.0101	-0.0001	-0.0198*
	(0.002)	(0.010)	(0.003)	(0.009)	(0.001)	(0.011)
Log of trade [t-1]	7.0647***	2.9173***	11.0470***	5.7276***	1.2069	2.2295***
	(1.783)	(1.044)	(3.479)	(1.711)	(1.848)	(0.827)
Conflict intensity index [t-1]	-0.7343	0.9465*	1.5862	0.6043	2.5453**	0.1107
	(0.763)	(0.555)	(1.103)	(0.721)	(1.093)	(0.349)
Cpia mean [t-1]	-20.9899***	6.5025	-2.9903	10.3185	-8.5252*	-3.7174
	(7.059)	(9.827)	(7.368)	(10.192)	(4.538)	(3.876)
Policy uncertainty index [t-1]	1.4434	-0.7579	5.4631*	0.1063	2.0087	1.7865**
	(1.734)	(1.172)	(2.996)	(1.586)	(1.931)	(0.889)
Democracy [t-1]	-0.2733***	-0.1508*	0.1679	0.1341	0.0918*	0.1252*
	(0.091)	(0.088)	(0.151)	(0.105)	(0.052)	(0.066)
Constant	6.4877	24.0574***	-66.7819***	-14.5319	-18.5833*	-12.4075***
	(13.538)	(7.824)	(18.445)	(12.521)	(10.420)	(4.813)
Observations	460	533	460	533	622	655
Number of id	30	31	30	31	33	34
Year FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7. Robustness checks

We present in this section two main robustness checks. First, we examine the effect of changing the definition of debt distress by fiscal crises Medas et al. (2018). This new dependent variable is built on four aspects taken from Baldacci et al. (2011): (i) credit events associated with sovereign debt, (ii) recourse to large-scale IMF financial support; (iii) implicit domestic public default, and (iv) loss of market confidence in the sovereign. This indicator is more comprehensive since it includes broad aspects of fiscal policy. Table 8 shows results, which is in line with priors.

It was also worthy to examine if our choice of 100 percent threshold for IMF's quota has an impact on results. As we see in the literature, the choice on the threshold of the quotas is different. Kraay and Nehru (2006) considered 50 percent, and more recently, Catão & Milesi-Ferretti (2014) used a threshold of 200 percent. Given these choices, we present Table 9 regressions using 50, 75, 150, and 200 percent thresholds. Results remain.

7.1. Robustness to change of dependent variable

Table 8: Using alternative dependent variable.

	Random complementary log-log model - Mundlack					
Fiscal crises	(1)	(2)	(3)	(4)	(5)	(6)
Discovery [t-1]	**1.1047****					
	(0.437)					
	0,1633					
Discovery [t-2]		**0.7601***				
		(0.445)				
		0.1159				
Discovery [t-3]			**0.2259**			
			(0.503)			
			0.0349			
Reserves [t-1]				**0.1458****		
				(0.062)		
				0.0216		
Reserves [t-2]					**0.0937**	
					(0.064)	
					0.0143	
Reserves [t-3]						**0.0295**
						(0.072)
						0.0046
Economic controls	YES	YES	YES	YES	YES	YES
Institutional controls	YES	YES	YES	YES	YES	YES
Observations	1,362	1,375	1,388	1,362	1,375	1,388
Number of id	39	39	39	39	39	39
Log likelihood	-578.1	-598.1	-611.1	-578.4	-598.4	-611.2
Wald chi2	27.45	25.41	23.96	27.45	25.41	23.98
Wald test pvalue	0.000590	0.00132	0.00233	0.000592	0.00132	0.00231
Rho(LR)	0.123	0.134	0.148	0.123	0.133	0.148
P-value(Rho)	4.64e-07	4.79e-06	5.19e-05	5.80e-07	6.14e-06	5.29e-05
AUROC	0.652	0.650	0.642	0.652	0.650	0.642
seAUROC	0.0125	0.0124	0.0123	0.0125	0.0124	0.0123

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.2. Changing quota's thresholds

Table 9: Robustness on quota's thresholds

	Random complementary log-log model - Mundlack											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Debt distress [t]	Quota 50%			Quota 75%			Quota 150%			Quota 200%		
Discovery [t-1]	**0.5866***			**0.6903***			**0.7373****			**0.7265****		
	(0.339)			**(0.352)**			**(0.350)**			**(0.349)**		
	0,1287			**0,141**			**0,1456**			**0,1429**		
Discovery [t-2]		**0.6078***			**0.7151****			**0.7593****			**0.7501****	
		(0.336)			**(0.342)**			**(0.342)**			**(0.341)**	
		0,1339			**0,1469**			**0,1507**			**0,1483**	
Discovery [t-3]			**0.4968**			**0.3519**			**0.4720**			**0.4724**
			(0.337)			**(0.346)**			**(0.351)**			**(0.351)**
			0,1095			**0,0724**			**0,0939**			**0,0936**
Economic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,362	1,375	1,388	1,298	1,312	1,326	1,295	1,309	1,323	1,295	1,309	1,323
Number of id	39	39	39	39	39	39	39	39	39	39	39	39
Log likelihood	-681.7	-689.1	-693.7	-635.7	-644	-648.9	-615.5	-624	-629.6	-612.7	-621.2	-626.9
Wald chi2	27.12	27.55	28.30	12.94	13.02	13.37	11.96	11.87	11.96	11.95	11.88	12
Wald test pvalue	0.000675	0.000567	0.000420	0.114	0.111	0.0998	0.153	0.157	0.153	0.153	0.157	0.151
Rho(LR)	0.186	0.182	0.177	0.307	0.301	0.293	0.295	0.289	0.280	0.295	0.289	0.280
P-value(Rho)	0	0	0	0	0	0	0	0	0	0	0	0
AUROC	0.717	0.720	0.724	0.743	0.744	0.746	0.742	0.740	0.741	0.754	0.752	0.753
seAUROC	0.00921	0.00911	0.00901	0.00950	0.00941	0.00929	0.00964	0.00961	0.00953	0.00948	0.00944	0.00937

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

8. Conclusion and policy implications

This paper investigates the effect of giant oil discoveries on the risk of oil-exporting countries being classified as "in debt distress." We proposed a multi-step identification strategy based on an empirical approach by applying Mundlack's (1978) correction and proposition of different specifications, which allows knowing the direction of the bias and correct for that. In all regressions, discoveries have a significant and positive impact on countries' likelihood of being "in debt distress." We also highlight heterogeneities on transmission channels based on countries' level of exports diversification. In concentrated economies, the public sector seems to have a crowding-out effect on the private sector and FDI, conversely main drivers in diversified countries. These results suggest that oil-exporting countries and lenders should pay more attention to growing debt issues in oil-exporting countries. Borrowers should adopt structural reforms to prevent procyclicity and foster strategies to diversify their economies.

Chapter 2: IMPACT OF OIL AND GAS DISCOVERIES ON COMPOSITION OF SPENDING IN DEVELOPING COUNTRIES.

1. Introduction

Over the last decades, oil and gas revenues in developing countries have represented a significant share of their export earnings and tax revenues. Most of these countries are characterized by a high level of export concentration and thus extreme dependency on variations of natural resources revenues. The greater economic reliance on oil and gas revenues in developing countries linked with the increasing number of discoveries explains the accrued interest on the fiscal response to resources revenues shocks. Countries' composition of public spending gives a good picture of economic priorities and allows assessment of the modification of government preferences after oil and gas discoveries. Following Arezki et al. (2017), which show theoretically and empirically that giant oil and gas discoveries have a significant and positive impact on investments in the years following the shock, this study aims to analyze how this increase impacts the composition of public spending. The authors found that the effect on the employment rate is negative for an extended period. Moreover, although financing oil and gas exploitation relies mainly on international oil and gas companies and international organizations, governments are involved in the process through State-Owned Enterprises (SOEs).

Furthermore, NRGI 2015 report shows that state participation has increased since the 1970s in developing countries leading to suspicion of a crowding-out effect of private investment and increasing opportunities for nepotism and corruption. Arezki and Brückner (2011) provide empirical evidence that oil rents increase bribery, leading to general welfare loss due to misallocation of government revenues. Robinson et al., (2006) confirm that oil booms give incentives to political leaders to remain in power. They use oil rents to finance their political ambitions by modifying the election outcomes. By doing so, the political elite misallocates revenues through nonproductive spending. These contributions provide foundations for analyzing the impact of oil and gas discoveries on expenditures. However, there is no empirical study of the effects of oil and gas discoveries on the composition of government spending.

It is also well-documented in the economic literature that developing countries' fiscal policy is more procyclical than high-income countries because of the negative correlation between fiscal balance and business cycle in the former group of countries. Lane, (2003), Ilzetzki and Vegh, (2008), Alesina et al., (2008). Alesina et al. (2008) explain the issue by a political agency dilemma. However, which sectors are winners and losers in developing countries that face high fiscal constraints? Do sectoral government spending respond significantly to oil and gas shocks in developing countries?

To our knowledge, this is the first study that explores the impact of oil and gas discoveries on the composition of government spending in developing countries. We show that discovering a new giant hydrocarbon field shifts priorities in developing countries from traditionally productive sectors such as education and health to the defense sector. As a result, spending on education and health decreases by 20% and 11%, and defense expenditures increase by 5% for all developing countries and about 28% for low-income countries. From a research perspective, our results are noteworthy regarding the modification of public goods delivery and, more generally, achieving sustainable development goals in developing countries. On the methodological side, this study discusses the endogeneity issue following Cust & Harding (2020) and treats this issue by using an endogenous treatment effect estimator. We use a panel of 96 countries, covering the period 1980-2010.

2. Literature review

2.1. Theoretical background of the evolution of public spending in developing countries

Wagner's law gives us insight into how government spending changes as the level of household income increases Wagner (,1958). It states that public expenditure increases with the standard of living. Besides, Musgrave (1969) reports that "the income elasticity of demand for public consumer goods is more than unity." The literature on the composition of government spending is established on Engel's law (Dorfman, 1955). It assumes that the composition of public expenditure changes from consumption expenditure to welfare expenditure when a positive shock occurs in incomes. According to Pigou, the size of the budget results from the equalization of the marginal social benefit and the

marginal social cost. The public sector is efficient when the composition of public expenditures depends on their marginal social benefit, and the composition of taxes minimizes the marginal social cost. In addition to the income level, the competitiveness of different political groups positively influences the probability of rent-seeking behavior. It thus ultimately modifies the level and composition of public spending (fiscal leviathan hypothesis). Conversely, Keynesian theory considers public spending as a determinant of economic expansion. Indeed, the State, in the aftermath of a political crisis, can revive the economy through the multiplier effect by increasing productive public spending. Consequently, this fiscal stimulus induces a positive effect on economic activity in the short term. This problem of reverse causality is discussed below in the econometric section.

2.2. Government expenditures and natural resource economics

The economic literature has studied the effect of natural resource revenues on different economic aggregates. The starting point was Sachs & Warner's (1995) study which provided an empirical underpinning to the natural resource curse.

- Natural resources abondance impact and military expenditures

Resource-rich countries face a greater likelihood of civil wars and insurrections, especially countries with significant ethnolinguistic fractionalization. Azam (1995) showed through a game theory model that governments arbitrate between two equilibrium solutions to allocate the resources resulting from the increase of the budget to remain in power. On the one hand, they can choose to increase military expenditures or, on the other hand, to provide "gifts" to their political opponents. The first option does not guarantee peace because the model does not consider political ideologies and the ethnic mapping of the country. In the latter option, opponents are still forced to resort to violence when the cost is less than the expected benefits from rebellion (Grossman, 1995). Thus, it appears empirically that resource revenues are a significant determinant of the probability and duration of civil war (Collier & Hoefflert, 1998).

The impact of international sanctions on military and non-military expenditures has also received attention in economic literature, mainly in MENA countries. For example, Chun (2010), found that shocks in oil revenues did not affect military spending on Iran, Kuwait, Saudi Arabia, Venezuela, and Nigeria during 1997-2007. On the contrary, Farzanegan (2011) used VARs analysis and argued that only military spending has reacted to international sanctions in Iran from 1959-2007. According to the author, social expenditures such as education, health, and culture have not significatively changed during this period. The main difference between these studies is the length of time; the latter analyzed the long-run effects on expenditures.

- Natural resources abondance and social spending

One of the seminal studies on the link between natural resources and social spending is Gylfason (2001). The author found a crowding-out effect of natural capital on human capital due to the exchange rate appreciation, the rent-seeking behavior, and disincentives of governments to invest in education and the bad feeling of security which drives politics in response to the influx of resources from the natural resources sector. In addition, the author found a significant and negative impact on the ratio of education on national income and years of schooling of girls and secondary school enrollment. We follow this study while correcting endogeneity issues of education spending because it is a dependency variable and not an abundance variable. Nishijima, Sarti, & Canuto (2020) found a null effect of exogenous shocks on health and education spending over the long term in Brasilian municipalities. Cockx & Francken (2014) have shown a negative relationship between natural resource dependence and abundance indicators on public health expenditures over the period 1995-2009, through an indirect effect on the deterioration of state accountability and volatility. Cockx & Francken (2016) also confirmed the adverse impact of natural resource abundance on human capital accumulation.

3. Data

This article uses a comprehensive panel dataset of 96 developing countries over the period 1980-2010[15]. Data are bounded by the availability of oil and gas discoveries.

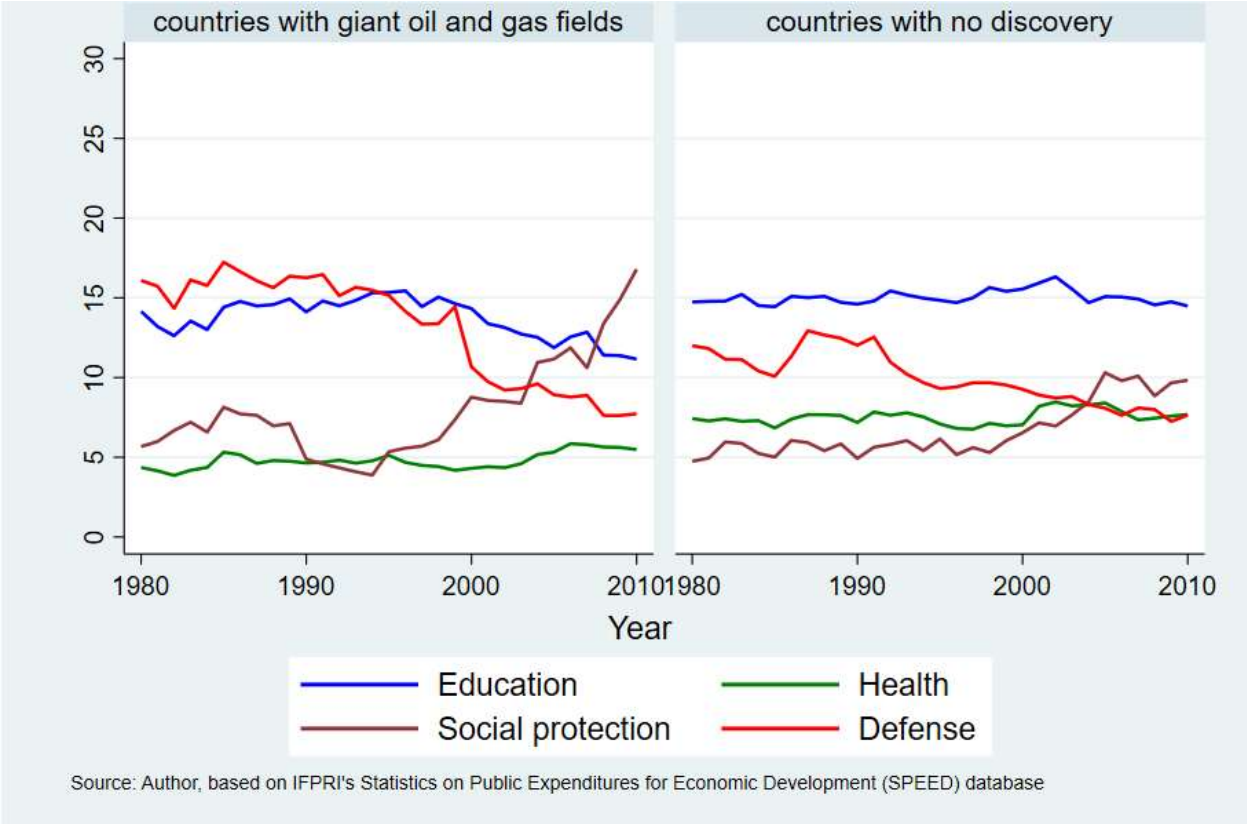
3.1. Public expenditures

The data of the composition of public spending are from IFPRI's Statistics on Public Expenditures for Economic Development (SPEED) database because it provides wide geographical coverage for developing countries. Our outcomes include three sectors: health, education, social protection, and defense[16], measured as the percentage of sector expenditure in total expenditure in constant 2005 PPP dollars. Figure 1 shows the evolution of each category of spending in countries where oil and gas were discovered and those where there was no discovery. In line with Chen(2019), we focus on productive public expenditures because of their contribution to enhancing the productivity of private capital. Each operational spending consists of providing public goods and services for households, cash transfer payments, or acquiring assets for the specific sector. We notice that education and health expenditures are lower on the same scale in countries that have not experienced discoveries. The opposite is true for defense spending, at least over the last twenty years. We notice that social spending is roughly the same (about 5%) between 1980-2010 before increasing drastically for countries that have experienced discoveries and after the 2000s for those that have not. In general, we notice that education spending is the most important in developing countries' governments' budgets. Expenditures on defense, health, and social protection follow.

[15] See Appendix B for more details on countries

[16] We provide definitions of each sector in appendix A. IFPRI's SPEED dataset follows definitions and functional classification of expenditures used by IMF's Government Finance Statistics Manual.

Figure 14: Percentage of sectoral expenditures in total expenditures in constant dollars PPP



3.2. Oil and gas discoveries

We use giant oil and gas discoveries that contain at least 500 Million Barrels of Oil Equivalent (MMBOE)[17] estimated ultimate recovery. Data are retrieved from Horn (2014) and cover 216 discoveries. Country statistics by five-year period presented in figure 2 show that oil and gas discoveries are highly concentrated in middle-income countries. About 65% of the discoveries occurred in Upper Middle-Income countries, especially in the Middle East and North African (MENA) region, 30% in Lower Middle-Income countries, and only 5% low-income countries.

[17] MMBOE is the measure used in energy and petroleum industry

Figure 2: Percentage of sectoral expenditures in total expenditures in constant dollars PPP

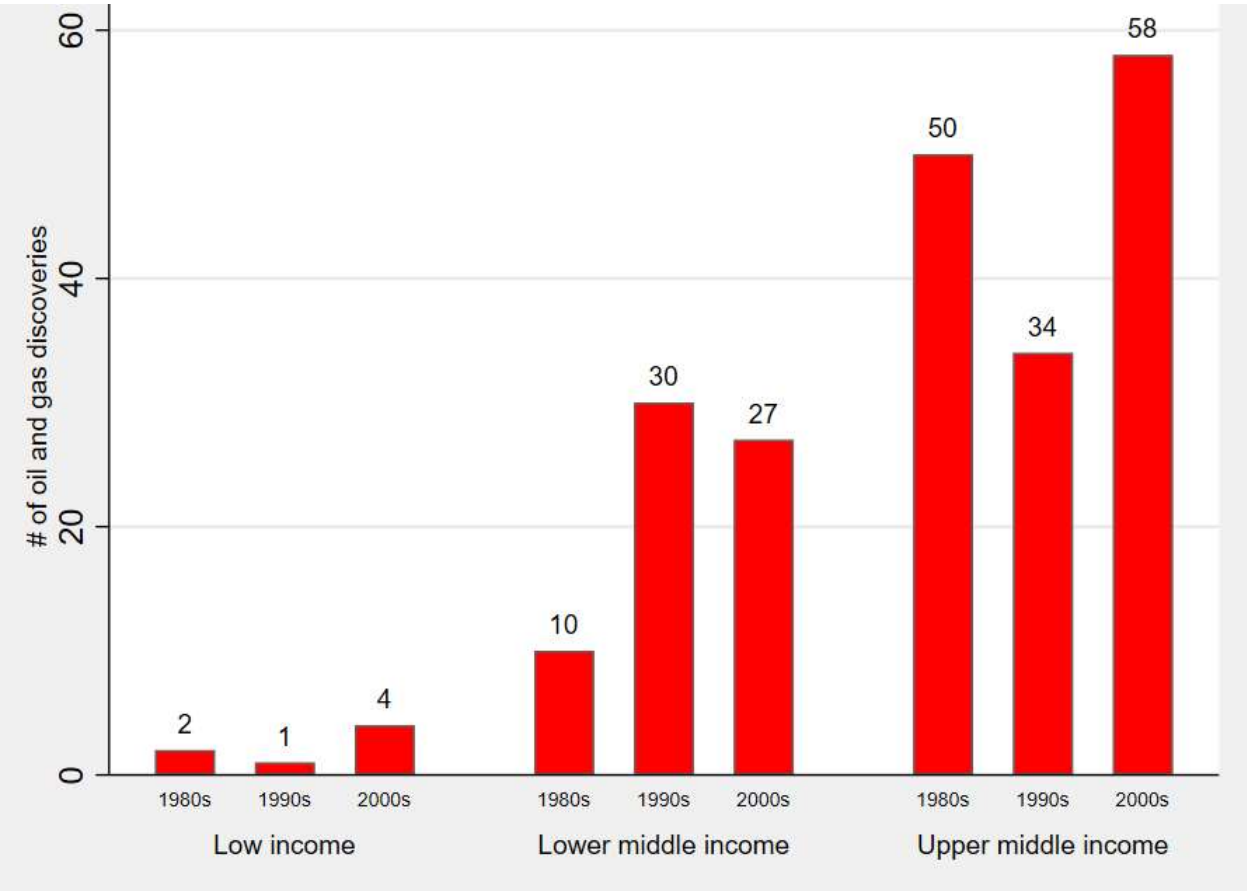


Figure 2 also shows the trend of discoveries over the period. Almost half of them occurred during the 2000s. This suggests a technological bias. As for Cust (2014), Arezki et al. (2017b), Masi (2019), we consider that giant oil and gas discoveries are significant output shocks, particularly for developing countries, and thus affect macroeconomic aggregates. In this article, we choose to focus on the modification of government spending after the discovery. Treatment is giant oil or gas discovery. We use one lag discovery for all estimations. The following section analyzes the endogeneity issue related to hydrocarbon giant fields discoveries and the length of time that effect lasts for each spending category.

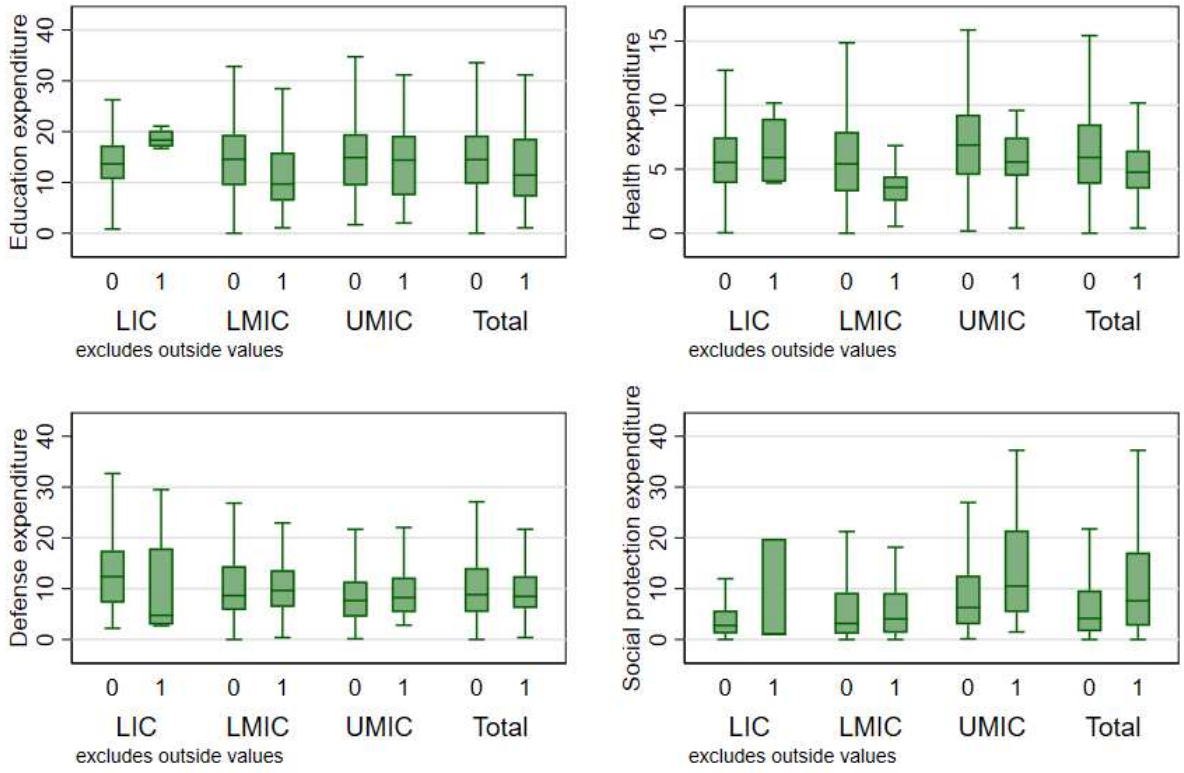
3.3. Controls

To identify the effect of oil and gas endowment on government spending, we control for variables that affect the composition of government spending and discoveries. To do this, we use

macroeconomic variables, proxies respectively for demography and institutions. For the first set of variables, we include the log of GDP per capita in PPP, remittances, Official Development Assistance (ODA) flows, and a total of extractive resources rents. The demographic structure is proxied by the dependency ratio. We also control for the electoral period (see Appendix C for description and sources of variables). We mainly relied on Bamba et al., (2019) and Cockx, (2014,2016) to choose these variables.

3. Descriptive statistics

Figure 3: Sector expenditures (% of total expenditure) across treatment and control group by income group

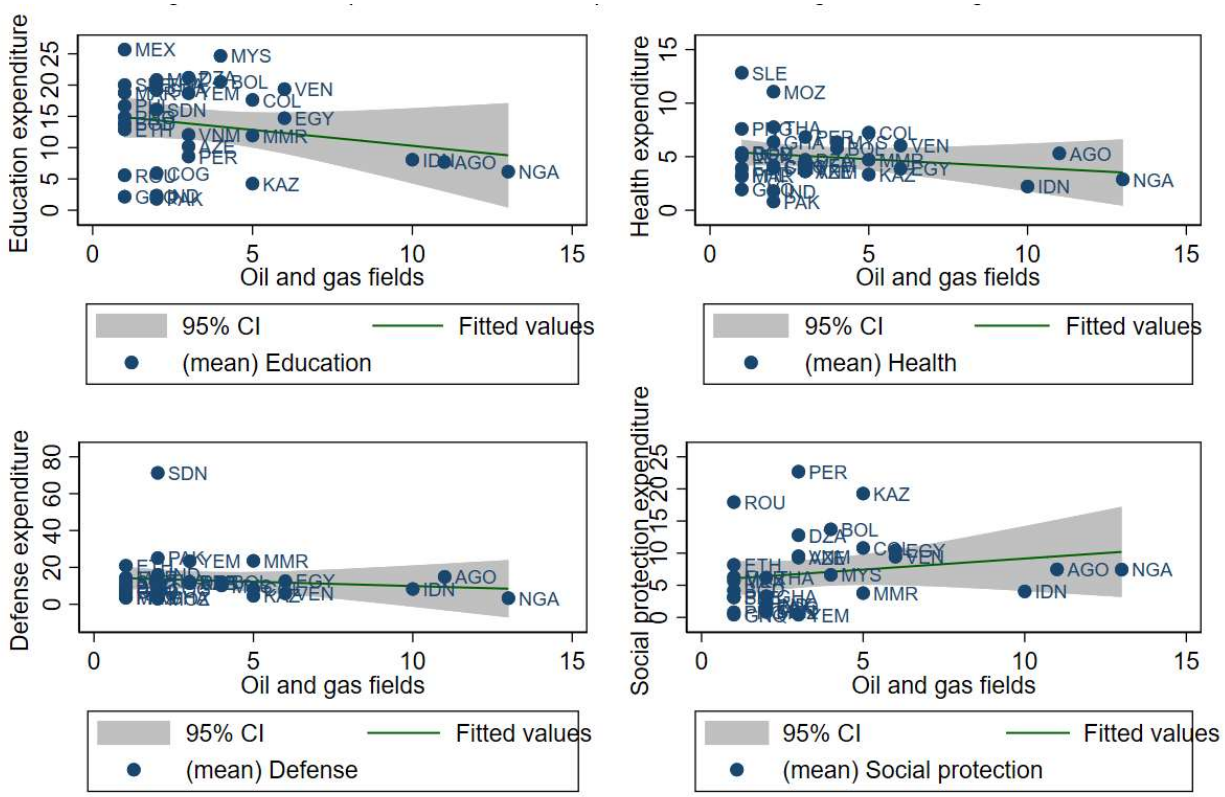


Source: Author, based on IFPRI's Statistics on Public Expenditures for Economic Development (SPEED) database

According to figure 3 education and health spending are higher in middle-income countries without oil and gas discoveries compared to the treatment group. Whereas, social protection expenditure is high in the treatment group. Defense spending is almost equivalent in both groups, except in low-income countries.

However, when we consider specifically income groups, we notice that spending on education and health are less important in the treatment group for countries with very low incomes only.[18] The regression lines below confirm this same trend for each sector.

Figure 4: Linear prediction of sectoral spending according to oil and gas fields



Source: Author, based on IFPRI's Statistics on Public Expenditures for Economic Development (SPEED) database

4. Methodology

4.1. Endogeneity issues of giant oil and gas discoveries

The choice of our empirical strategy is strongly influenced by development on the questions of endogeneity of natural resource extraction. This section discusses that unobservable factors could affect public expenditures and the probability of discovering commercial oil or gas wells. We suspect

[18] The same graph is available in appendix D, for heterogeneities by region

that countries with a high level of productive expenditures attract more foreign investors and thus increase the likelihood of having external funds for exploration activities. Conventional hydrocarbons exploration costs have increased since world war II, considering that accumulation occurs in deep water, thus requiring sophisticated engineering and materials. Deep and ultra-deep-water expenses can reach $1 billion in deep-water regions like Brazil(Max and Johnson, 2016, p. 78). For those reasons, we postulate that country's attractiveness influences exploration. Government expenditures are, in essence, a significant determinant of the country's attractiveness.

Attractiveness is linked to many institutional variables but includes a wide range of concepts related to existing infrastructures:

- Liberties in the management of foreign companies assets
- Management of port facilities and existing refineries
- Access to traditional oil and gas corridors
- Country's socio-ecological engagement
- Insecurity in borders: the presence of armed gangs
- Existing drilling activities or services
- Discretionary policies to encourage exploration

As in Lei & Michaels (2014), we can also assume a measurement error of URR reserves, depending on estimation methods. Therefore, the prices of raw materials would not be the main determinants of exploitation since most discoveries took place when prices were low or stable.

4.2. The endogeneity of oil exploration

The countries' stability determines exploration costs and, therefore, oil and gas discoveries are considered endogenous (Arezki & Brückner 2011). For example, violent conflicts and insecurity in corridors have impeded oil and gas exploration in Sudan since the first oil discovery in 1950 in the country's South East. Thus, identifying the effect of sectoral spending on discovery requires control for attractiveness.

Similar studies pointed out the endogeneity issue of discoveries. Cust & Harding (2014) have emphasized that institutions significantly influence drilling activities. They found that, at borders, oil and gas explorations took place 58% of the time where institutions are better. The authors identified three sources of endogeneity : (1) geology which directly influences the unobservable likelihood to experiment a discovery, (2) the quality of institutions, and (3) both of them simultaneously. Their challenge was to empirically identify the exogenous effect of discoveries by controlling for institutions and other unobservable. To achieve this, Cust & Harding (2014)took advantage of the location of national borders determined independently. Cotet & Tsui (2013) and Cavalcanti, Da Mata, & Toscani (2019) suggest using the randomness in the size of discoveries to investigate the impact of oil reserves on institutions and conflicts. This paper is in the same vein as previous studies, and we control for endogeneity using two geological instruments: area size, landlocked status, and democratic status.
We assume that area size and democracy is correlated with the likelihood of discovering a new giant field. On the contrary, landlocked countries have a lower probability of exploration because they face higher operational and transportation costs. This is supported by the fact that a significant share of oil and gas is shipped by sea (Keen, 2016). Therefore, being closer to an export port is a considerable advantage and thus could be considered as a determinant of exploration for petroleum companies. We also test empirically the endogeneity hypothesis to support our choice, and the results are consistent with our arguments.

4.3. Empirical strategy

As mentioned above, we suspect nonrandom exploration of oil and gas fields based on unobservables. We have summarized these latent characteristics by the country's attractiveness. Given that traditionally treatment-effects estimators are inconsistent[19]. We use the model described by the following general equation with endogenous right-hand treatment D :

[19]Commonly treatment-effects estimator rely on three assumptions : (1) Conditional independence: It means that after controlling by covariates for X, there are no unobserved effects beyond treatment effect that affect outcomes. (2) Overlap condition: guarantees that each

$$Y^* = X'\beta + D\gamma + \varepsilon, Y = 1, (Y^* = 1); Cov\,(D, \varepsilon) \neq 0$$

We can illustrate this as follows:

$$\begin{cases} Y_{it}^0 = E(Y_{it}^0 | X_{it}) + \varepsilon_{it}^0, \qquad Y_{it}^1 = E(Y_{it}^1 | X_{it}) + \varepsilon_{it}^1 & (i) \\ D_{it} = D_{it} | Z_{it} + \mu_{it} & (ii) \\ Y_{it} = D_{it} Y_{it}^1 + (1 - D_{it}) Y_{it}^0 & (iii) \\ E(\varepsilon_{it}^j | X_{it}, Z_{it}) = E(\varepsilon_{it}^j |, Z_{it}) = E(\varepsilon_{it}^j |, X_{it}) = 0 & (iv) \\ E(\varepsilon_{it}^j |, D_{it}) \neq 0 & (v) \end{cases}$$

For all treatment status $j = 0, 1$, country $i = 1, .., N$ and time $t = 1, ...T$. Y_{it}^0 and Y_{it}^1 are outcomes respectively share of sector expenditure for countries that have discovered at least one giant field and those with no discovery for country i at time t. Y denotes *education*, *health, social protection,* and *defense.* X indicates the first set of covariates: log of GDP per capita (*GDP*), Official Development Assistance (*ODA Gini*), remittances to GDP, executive election, natural resources rents (*rents*), and dependency ratio. We observe only one of Y_{it}^0 and Y_{it}^1 for each country and time. Z is the second set of variables which include exogenous covariates in X and instruments: dependency ratio, area (*area*), landlocked and democratic status. $D_{it} = 1$ and $D_{it} = 0$ denotes respectively treatment and no treatment for country i and time t and μ_{it} is an unobserved component.

Equation (v) is the difference from the conventional framework and reflects the endogeneity of spending equations (i) with respect to the probability of discovering a new giant oil or gas field. This is particularly true for productive spending we are studying, as these contribute to increase attractivity.

individual in treatment and control groups at any time period could receive any treatment. (3) The independent and identically distributed (i.i.d.) assumption: This ensures that outcomes and treatment status of individual i are independent to those of country j.

To control for endogeneity in the model, we implement a control-function estimator Joshi and Wooldridge (2019) and derive the treatment effect on the treated (*ATET*) based on conditional probability. Our estimator is a two-step approach. In the first stage, equation $D_{it} = D_{it}|\, Z_{it} + \mu_{it}$ (ii) , which is equivalent to $E(D_{it}|\, Z_{it}) = E(\varepsilon_{it}|\, E(Z_{it}) + \mu_{it}) = E(\varepsilon_{it}|\, \mu_{it})$ is estimated with a probit estimator, and the residual is included in the second stage to the linear outcome equation (i). The ATET is thus derived using the generalized method of moments (GMM) method.

5. Empirical results

5.1. Baseline results: treatment effects

Baseline results confirm that the education and health sectors are affected by giant oil and gas discoveries by 19.6% and 11.4% compared to the treatment group. Conversely, the social protection and defense sectors benefit from 25.1% and 5.6%, respectively. Table 1a confirms that using an endogenous estimator is appropriate. For the other explanatory variables, we find that official development assistance positively influences health spending and has a negative impact on defense spending. This result is consistent with the economic literature. In addition, remittances have a crowding-out effect on public health spending through the possibility of subscribing to private insurance systems. We also find a significant and positive impact of the election period on education and health spending. This result is consistent with those of Brender and Drazen (2013).

Table 1: Impact of oil and gas discoveries on the composition of public spending

	Education	Health	Social protection	Defense
Discovery (ATET)	**-19.560*** (3.037)**	**-11.417*** (2.286)**	**25.037*** (7.464)**	**5.586** (2.719)**
GDP	-0.223 (.2175)	-0.015 (.073)	-0.474** (.231)	0.162 (.160)
ODA Gini	0.119 (.178)	0.234*** (.060)	-0.005 (.273)	-0.308** (.123)
Remittances to GDP	0.143 (.097)	-0.081** (.034)	-0.462 (.558)	1.058*** (.153)
Rents	-0.090* (.052)	0.028 (.018)	0.1248 (.080)	-0.025 (.053)
Executive elections	3.890* (2.059)	1.530*** (.490)	1.412 (2.204)	0.967 (1.323)
Dependency ratio	0.075 (.141)	-0.043 (.043)	-.384** (.182)	-0.075 (0.108)
#Observations	1 394	1 375	1 330	1 296

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 1a: Endogeneity test on outcomes

	Education	Health	Social protection	Defense
Chi2(2)	**49.11*** (0.000)**	**40.29*** (0.000)**	**27.82*** (0.886)**	**20.19*** (0.000)**
Observations	1 394	1 375	1 330	1 296

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

Tables 2 and 3 show the differences in results between the subgroups of low-income and middle-income countries. We chose to add the lower-middle-income countries to low countries as we noticed from figure 2 that the discoveries are concentrated in the upper-middle-income group. We, therefore, decided to treat this subgroup specifically. Table 2 shows that although low-income countries have the greatest need for resources in the health and education sectors, discovering new oil and gas fields leads to a threefold decrease in the ratio of education and health expenditures to total expenditures. Social protection spending decreases for low-income countries in table 2 and leads to higher defense expenditures. We assume that this crowding-out effect benefits the defense sector, given that some of these countries are experiencing internal or external conflicts. We have tested this hypothesis in the section of the transmission channels. Other sectors more prone to white elephants, such as the transport and communications sector, also benefit from this reduction in social spending in proportion. However, we have not included them in this study due to data availability.

Table 2: Impact of oil and gas discoveries on the composition of public spending only for Low Income and Lower Middle-Income countries

	Education	Health	Social protection	Defense
Discovery (ATET)	**-59.576*** (12.178)**	**-31.090*** (6.797)**	**-22.598*** (8.427)**	**28.026*** (8.249)**
GDP	-0.654** (0.278)	-0.133* (0.074)	-0.503 (0.734)	-0.604** (0.289)
ODA Gini	0.543*** (0.114)	0.281*** (0.053)	-0.366 (0.298)	-0.420*** (0.158)
Remittances to GDP	0.237*** (0.061)	-0.056** (0.025)	0.096 (0.689)	1.014*** (0.126)
Rents	-0.043 (0.061)	0.041* (0.021)	0.106 (0.118)	-0.050 (0.110)
Executive elections	1.218 (1.128)	1.542*** (0.532)	-4.937* (2.911)	-1.625 (1.814)
Dependency ratio	-0.339 (0.157)	-0.078 (0.051)	-0.133 (0.458)	-0.265 (0.382)
#Observations	846	835	780	783

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 2a: Endogeneity test on outcomes

	Education	Health	Social protection	Defense
Chi2(2)	**18.02*** (0.000)**	**16.50*** (0.000)**	**7.96** (0.019)**	**11.58*** (0.003)**
Observations	846	835	780	783

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

Table 3: Impact of oil and gas discoveries on the composition of public spending for Upper Middle-Income countries.

	Education	Health	Social protection	Defense
Discovery (ATET)	**-17.001*** (3.551)**	**-7.579*** (2.225)**	**35.087*** (8.182)**	**1.164 (1.983)**
GDP	-0.537** (0.254)	0.065 (0.068)	0.108 (0.192)	0.358** (0.173)
ODA Gini	-6.448*** (2.000)	-3.925*** (0.649)	-1.706 (4.092)	0.237 (3.414)
Remittances to GDP	2.190 (1.559)	0.747** (0.340)	-3.373*** (1.282)	0.557 (0.960)
Rents	-0.115 (0.091)	-0.074** (0.030)	-0.138 (0.103)	0.031 (0.102)
Executive elections	3.126* (1.719)	0.677 (0.532)	2.207 (2.231)	1.781 (1.624)
Dependency ratio	0.639*** (0.180)	-0.036 (0.074)	-0.450* (0.270)	0.032 (0.174)
#Observations	548	540	550	513
Endogeneity	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 3a: Endogeneity test on outcomes

	Education	Health	Social protection	Defense
Chi2(2)	**27.31*** (0.000)**	**14.52*** (0.000)**	**23.94** (0.000)**	3.73 (0.155)
Observations	548	540	550	513

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

The efficiency of social spending

This section assesses whether the reduction of health and education spending reported in Tables 2 and 3 is caused by a better performance of the health and education system. To do this, we tested two outcomes variables for health and education spending: out-of-pocket expenditures to capture contributions paid by patients and secondary enrollment. We assume that the secondary school enrollment rate shows the efficiency of education spending in keeping children in the education system after promoting registration in primary school. The results show that the share of out-of-pocket expenditures in current total expenses increases by about 30% in our sample of countries. Moreover, the enrolment rate in secondary education decreases by around 10% after a giant oil or gas discovery. This result means that the decrease in spending in the education and health sectors does not go hand with efficiency.

Table 4: Efficiency of spending - Impact of oil and gas discoveries on school enrollment secondary and Out-of-pocket expenditure

	health OOP	Secondary enrollment
Discovery (ATET)	**29.852*** **	**-9.735**
	(10.726)	**(9.581)**
GDP	0.553	-0.832*
	(0.935)	(0.502)
ODA Gini	-2.135	-0.195
	(1.120)	(0.331)
Remittances to GDP	-0.617	4.226**
	(1.851)	(1.953)
Rents	-0.096	0.414**
	(0.502)	(0.192)
Executive elections	-7.586	2.089
	(5.195)	(4.578)
Dependency ratio	0.922	-2.6242***
	(0.765)	(0.403)
#Observations	873	1 409

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 4a: Endogeneity test on outcomes

	health OOP	Secondary enrollment
Chi2(2)	**7.88***	**24.73***
	(0.019)	**(0.000)**
Observations	873	1 409

The issue of inefficiency is genuine when one looks at the results for the subgroup of low- and lower-middle-income countries in table 5. We find that in this subgroup, where the decline in social spending was the largest, there was a more significant decline in efficiency, increasing out-of-pocket expenditure of about 115% and high school enrollment of almost half the initial rate.

Table 5: Efficiency of spending - Impact of oil and gas discoveries on school enrollment secondary and Out-of-pocket expenditure

	health OOP	Secondary enrollment
Discovery (ATET)	**114.536*** (42.077)**	**-57.177*** (12.210)**
GDP	0.628 (2.536)	-1.830 (1.536)
ODA Gini	-2.742** (1.143)	-0.117 (0.421)
Remittances to GDP	-3.330 (2.511)	3.680 (2.938)
Rents	-1.061 (1.126)	-0.082 (0.368)
Executive elections	-18.819 (12.721)	-5.002 (8.701)
Dependency ratio	1.005 (1.284)	-3.173*** (0.777)
#Observations	550	550

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 5a: Endogeneity test on outcomes

	health OOP	Secondary enrollment
Chi2(2)	**6.38** (0.019)**	**16.26*** (0.000)**
Observations	873	865

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

Conversely, we find a slight efficiency gain in the education and health sectors for the upper-middle-income subgroup. As a result, out-of-pocket spending slightly decreased by about 10%, and the secondary enrollment rate increased by 37%.

Table 6: Efficiency of spending - Impact of oil and gas discoveries on school enrollment secondary and Out-of-pocket expenditure

	health OOP	Secondary enrollment
Discovery (ATET)	**-10.918*** (9.105)**	**37.103*** (7.925)**
GDP	0.417 (0.7164)	0.666 (0.468)
ODA Gini	5.414 (4.698)	-28.273* (14.522)
Remittances to GDP	-4.913 (7.810)	12.022** (5.824)
Rents	0.799*** (0.298)	0.012 (0.195)
Executive elections	7.002*** (2.606)	-2.226 (3.700)
Dependency ratio	0.826 (0.557)	-2.034*** (0.507)
#Observations	323	494

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 6a: Endogeneity test on outcomes

	health OOP	Secondary enrollment
Chi2(2)	**5.07* (0.079)**	**25.84*** (0.000)**
Observations	323	494

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

Table 7 gives insight into the persistence of the negative effect of oil and gas discoveries on the composition of public expenditure. We notice that education is the sector that is the most affected by the decrease. Over 20 years, the negative effect is significant and between 15 and 33%. The negative impact in the health sector is lower (about 10%) and disappears after ten years. The two

sectors that benefit from oil and gas discoveries are the social protection and defense sectors. The coefficients associated with the social protection sector are more significant over the period and more important (about 20 and 87%). The defense sector also benefits from the boom. However, the significance of the coefficients is less stable over the period. The reason for this could be the sensitive nature of defense data.

Table 7: Persistence of impact of oil and gas discoveries on the composition of public spending over time.

	Education	Health	Social protection	Defense
Lag specification				
[t+2]	-19.166***	-10.650***	26.713***	4.075*
	(3.052)	(2.158)	(7.837)	(2.444)
[t+4]	-19.094***	-8.629***	34.014***	0.339
	(3.206)	(2.129)	(9.012)	(2.443)
[t+6]	-17.892***	-8.058***	34.468***	3.702*
	(3.133)	(2.023)	(8.746)	(2.406)
[t+8]	-18.443***	-7.997***	36.043***	2.524
	(3.512)	(2.064)	(9.642)	(2.600)
[t+10]	-19.306***	-9.470***	34.819***	6.887*
	(4.800)	(2.617)	(10.252)	(4.030)
[t+12]	-18.510***	-4.139*	56.372***	10.880*
	(3.133)	(2.397)	(14.316)	(5.420)
[t+14]	-15.365***	-0.187	68.475***	13.840**
	(6.428)	(1.960)	(16.617)	(7.004)
[t+16]	-20.503**	0.953	86.568***	16.099
	(7.946)	(1.689)	(23.055)	(10.254)
[t+18]	-32.619***	-7.085	75.915***	1.862
	(10.735)	(4.566)	(21.237)	(10.183)
[t+20]	-29.251***	-6.887*	65.600***	-2.578
	(9.080)	(4.176)	(19.173)	(8.576)

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

5.2. Transmission channels

In this section, we want to know the variables that influence the relationship between the discoveries and the composition of public expenditure. According to the economic literature, we considered the following variables: the degree of government polarization and the degree of risk of internal and external conflicts.

Polarization and composition of spending: The variable polarization is retrieved from the Database of Political Institutions (2017) and equals 0 when elections are not competitive. The chief executive's party has an absolute majority in the legislature. Otherwise, it is the maximum polarization between the executive party and the four principal parties of the legislature. The assumption is that in highly polarized countries, discretionary spending increases, unlike other types of spending.

The results reported in Table 8 show that defense spending increases drastically by 20% when power is polarized due to its discretionary nature. Conversely, we find that social protection spending increases for low-polarized countries. This is consistent with the concept of the voracity effect (Tornell & Lane, 1999). The diversity of the political players in a context of weak institutions leads to a more than proportional increase in spending. In both cases, health and education spendings fall proportionately following a discovery.

Conflicts and composition of spending: Lei & Michaels (2014) have highlighted that giant oil and gas discoveries increase the probability of internal conflict, especially for countries that have already experienced political violence. In the same vein, we postulate that the risk of conflict may change the composition of sectoral public spending. We extend this hypothesis to external conflicts since securing borders may be an issue for the extraction activity. The internal conflict variable measures the potential or actual impact of political violence on the government. The highest score is assigned to countries with a low risk of civil disorder, terrorism, civil war, and vice versa. Table 9 shows that countries with a high risk of political violence significantly increase defense spending over

health, education, and social protection. The average defense spending in countries with an important risk of conflict is almost 90% higher than in countries with low risk. This preference for the defense sector affects health and education by 30% and 15%, respectively.

We also test the effect of external conflicts (war, cross-border conflict, and foreign pressures) on the interaction between the composition of government spending and oil and gas discoveries. The results follow a similar pattern to the previous ones, with a positive bias for defense spending. Health and education spending are negatively affected but to a lesser extent compared to internal conflicts. On average, social protection spending decrease by 13% in countries exposed to external conflicts and experiencing an oil and gas discovery. Conversely, we find an increase of about 15% in countries at lower risk of external conflicts. This finding supports the fact that social protection systems are ineffective in conflict areas because of the migration of populations.

Table 8: Impact of oil and gas discoveries on the composition of public spending according to the level of polarization

	Education		Health		Social protection		Defense	
	Low level of polarization	High level of polarization	Low level of polarization	High level of polarization	Low level of polarization	High level of polarization	Low level of polarization	High level of polarization
Discovery (ATET)	-21.436***	-4.084*	-2.410***	-9.136***	51.699***	-8.787***	-3.339	20.349***
	(5.277)	(2.222)	(2.137)	(1.494)	(14.039)	(2.226)	(2.391)	(5.133)
#Observations	396	1 018	392	1 003	374	977	350	967
Endogeneity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Internal conflicts

Table 9: Impact of oil and gas discoveries on the composition of public spending according to the level of internal conflict risk

	Education		Health		Social protection		Defense	
	Low risk of internal conflict	High risk of internal conflict	Low risk of internal conflict	High risk of internal conflict	Low risk of internal conflict	High risk of internal conflict	Low risk of internal conflict	High risk of internal conflict
Discovery (ATET)	-6.726***	-30.476***	-6.352***	-15.346**	3.730	29.931	5.320***	89.133***
	(1.889)	(10.807)	(1.133)	(5.970)	(3.918)	(25.292)	(1.975)	(31.647)
#Observations	875	539	871	524	839	512	978	524
Endogeneity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

External conflicts

Table 10: Impact of oil and gas discoveries on the composition of public spending according to the level of external conflict risk

	Education		Health		Social protection		Defense	
	Low risk of external conflict	High risk of external conflict	Low risk of external conflict	High risk of external conflict	Low risk of external conflict	High risk of external conflict	Low risk of external conflict	High risk of external conflict
Discovery (ATET)	-11.034*** (2.635)	-6.052* (4.262)	-6.523*** (1.407)	-9.5319*** (2.462)	15.125** (6.439)	-13.158*** (3.347)	1.968 (2.079)	39.597*** (12.841)
#Observations	893	521	885	510	840	511	806	511
Endogeneity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

6. Robustness checks

The purpose of this section is to test the sensitivity of the results to our sample. Following Arezki et al. (2017), we remove country groups and mega and supergiant discoveries to verify that the different effects observed are not driven by countries that experienced megagiant or supergiant discoveries. Megagiant discoveries are greater than 10 Billion BOE or 60 trillion cubic feet of gas and supergiants fields more significant than 5 Billion BOE or 30 trillion cubic feet of gas.

We notice that the results presented in Table 11 confirm the results that were presented in two sectors. The health and education sectors are still negatively affected by the discoveries. The education sector shows a significant and negative decline of about 9% and the health sector a decline of about 8% compared to countries that did not experience discoveries. The coefficient associated with the social protection sector is not significant, and the coefficient for defense is significant and negative. These results suggest that the increase in social protection and defense spending observed above is driven by countries that have experienced megagiant and supergiant discoveries. These results are similar to those in table 13. We have removed the Middle East and North Africa (MENA) countries. The results confirm the negative impact of the discoveries on education and health spending, with an increase in defense spending. We removed the onshore discoveries, which constitute the main part of the discoveries, in Table 12. The results show that the conclusion that education and health expenditures are declining is confirmed. We also find that spending on social protection and defense is significant and increases by 10% and 13%, respectively. These results are in line with Cockx and Francken's (2014, 2016) work on the harmful effects of natural resource dependence on health and education spending, respectively.

The shift in government priorities explains the negative effect of discoveries on social spending. Since the hydrocarbon sector is more capital-intensive and less skill-intensive, the government reorganizes its spending to focus on security to facilitate the installation of physical capital. As a result, the health and education sectors are no longer prioritized. According to Farzanegan's (2011) study, military

expenditures are financed mainly by the natural resources sector, 60% of the Iranian government's revenues, and 90% of Iranian exports. Moreover, it demonstrates that military spending responds significantly and positively to shocks in the natural resource sector.

Regressions without megagiant and supergiant discoveries

Table 12: Impact of oil and gas discoveries on the composition of public spending without megagiant and supergiant discoveries

	Education	Health	Social protection	Defense
Discovery (ATET)	-9.273***	-7.815***	5.346	- 13.764***
	(2.241)	(1.272)	(4.761)	(3.842)
GDP	-0.336	-0.036	0.040	0.125
	(0.291)	(0.088)	(0.079)	(0.197)
ODA Gini	0.052	0.227***	0.052***	-0.055
	(0.214)	(0.070)	(0.214)	(0.277)
Remittances to GDP	0.577**	-0.045	0.093	1.527***
	(0.237)	(0.058)	(0.035)	(0.238)
Rents	0.025	0.048	0.000	-0.010
	(0.090)	(0.031)	(0.005)	(0.079)
Executive elections	2.403	1.687**	1.911***	-0.277
	(2.288)	(0.684)	(0.646)	(1.550)
Dependency ratio	0.009	-0.069	-0.570***	-0.040
	(0.159)	(0.047)	(0.041)	(0.131)
#Observations	1 410	1 391	1 347	1 313
Endogeneity	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 6a: Endogeneity test on outcomes

	Education	Health	Social protection	Defense
	16.67* **	**52.27*** **	**0.73**	**16.22*** **
Chi2(2)	**(0.000)**	**(0.000)**	**(0.693)**	**(0.000)**
Observations	548	540	550	513

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

6.1. Regressions without MENA countries

Table 7: Impact of oil and gas discoveries on composition of public spending without megagiant and supergiant discoveries

	Education	Health	Social protection	Defense
	-11.173* **	**-7.720*** **	**6.264**	**9.390*** **
Discovery (ATET)	**(2.432)**	**(1.356)**	**(5.166)**	**(3.444)**
	-0.903**	-0.309***	-0.778	-0.417
GDPt	(0.342)	(0.095)	(0.546)	(0.259)
	0.296*	0.257***	-0.224	-0.262
ODA Gini	(0.173)	(0.080)	(0.238)	(0.212)
	-0.156	-0.340	-1.422**	2.502**
Remittances to GDP	(0.573)	(0.159)	(0.715)	(1.200)
	-0.208**	-0.0587	-0.168	-0.153
Rents	(0.010)	(0.037)	(0.177)	(0.107)
	0.489	1.509	6.703	-2.123
Executive elections	(2.456)	(0.942)	(5.205)	(1.921)
	-0.246	-0.159***	-0.516	0.074
Dependency ratio	(0.178)	(0.046)	(0.390)	(0.158)
#Observations	1 209	1 190	1 153	1 112
Endogeneity	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 7a: Endogeneity test on outcomes

	Education	Health	Social protection	Defense
Chi2(2)	17.49*** (0.000)	39.93*** (0.000)	0.24 (0.889)	10.89*** (0.004)
Observations	1 209	1 190	1 153	1 112

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

6.2. Regressions for offshore discoveries

Since most of the discoveries are made offshore, we remove the countries that have onshore discoveries. The results in Table 8 confirm our previous findings with a decline of 13% in education spending and 9% in health spending. Conversely, spending on social protection increases by 10% and 13% for defense spending.

Table 8: Impact of oil and gas discoveries on the composition of public spending for offshore discoveries

	Education	Health	Social protection	Defense
Discovery (ATET)	-13.221*** (2.677)	-8.527*** (1.570)	10.248* (6.146)	13.270*** (4.469)
GDP	-0.596* (0.338)	-0.165* (0.096)	-0.439 (0.410)	-0.099 (0.220)
ODA Gini	0.061 (0.208)	0.232*** (0.208)	-0.312 (0.195)	-0.116 (0.263)
Remittances to GDP	0.533** (0.214)	-0.048 (0.068)	-1.187* (0.695)	1.450** (0.207)
Rents	0.016 (0.110)	0.031 (0.037)	-0.065 (0.151)	-0.105 (0.097)
Executive elections	1.888 (2.317)	1.730** (0.825)	6.393 (4.114)	-1.064 (1.357)
Dependency ratio	-0.073 (0.183)	-0.108** (0.050)	-0.462 (0.297)	0.041 (0.154)
#Observations	1 373	1 190	1 311	1 276
Endogeneity	Yes	Yes	Yes	Yes

Notes: Constant term not displayed. Standard errors are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 8a: Endogeneity test on outcomes

	Education	Health	Social protection	Defense
Chi2(2)	**22.04*** (0.000)**	**38.81*** (0.000)**	**1.63 (0.442)**	**13.29*** (0.001)**
Observations	1 373	1 190	1 311	1 276

Notes: P-values are in parentheses. Significance levels are as follows: * p<0.10, ** p<0.05, *** p<0.01

7. Conclusion and policy implications

This paper analyzes the impact of oil and gas discoveries on the composition of public spending, namely education, health, social protection, and defense. It follows previous empirical papers on the effect of natural resource abundance on human capital accumulation (Gylfason, 2001; Cockx & Francken, 2014, 2016) and defense (Farzanegan, 2011). However, instead of the traditional measures of abundance, we use the variability of giant oil and gas discoveries to identify an exogenous effect on sectoral expenditures in developing countries. The specificity of this paper is to take the risky gamble of considering giant discoveries as endogeneous and correct for this by using the control function estimation method. The results confirm the crowding-out effect of natural capital spending on human capital and give mitigated results for social protection spending. This result may be because social protection data in developing countries, essentially social transfer data, are not always available. In terms of economic policy recommendations, we invite governments to work with oil and gas companies to take concrete action to boost human capital in the countries where they operate. Following Cockx & Francken (2014, 2016), this can be done through health and education indicators in their CSR policy.

Appendix A: list of countries

Countries in bold are those which have already discovered at least one giant oil or gas field between 1980-2010

1	Afghanistan	**Colombia**	Iran (Islamic Republic of)	**Namibia**	Syrian Arab Republic
2	Albania	**Congo**	Jamaica	Niger	**Thailand**
3	**Algeria**	Costa Rica	Jordan	**Nigeria**	Togo
4	**Angola**	**Cote d'Ivoire**	**Kazakhstan**	**Pakistan**	Tonga
5	**Azerbaijan**	Democratic Republic of the Congo	Kenya	**Papua New Guinea**	Tunisia
6	**Bangladesh**	Dominican Republic	Kyrgyzstan	Paraguay	Turkey
7	Belarus	Ecuador	Lebanon	**Peru**	Uganda
8	Belize	**Egypt**	Lesotho	Philippines	Ukraine
9	Benin	El Salvador	Liberia	Republic of Moldova	United Republic of Tanzania
10	Bhutan	**Equatorial Guinea**	Madagascar	**Romania**	Vanuatu
11	**Bolivia (Plurinational State of)**	**Ethiopia**	Malawi	Russian Federation	**Venezuela (Bolivarian Republic of)**
12	Botswana	Fiji	Malaysia	Rwanda	**Viet Nam**
13	**Brazil**	Gambia	Maldives	Saint Vincent and the Grenadines	**Yemen**
14	Bulgaria	Georgia	Mali	Senegal	Zambia
15	Burkina Faso	**Ghana**	Mauritius	Serbia	Zimbabwe
16	Burundi	Grenada	Mexico	**Sierra Leone**	
17	Cameroon	Guatemala	Mongolia	South Africa	
18	Cape Verde	Guinea-Bissau	**Morocco**	Sri Lanka	
19	Central African Republic	**India**	**Mozambique**	**Sudan**	
20	**China**	**Indonesia**	**Myanmar**	Swaziland	

Appendix B: Functional classification of expenditures used as dependent variables, based on the following GFS- IMF desegregation

Variables	Components
	1.2 Medical products, appliances, and equipment 1.2 Outpatient services

1. Health	1.3 Hospital services 1.4 Public health services 1.5 Research and Development health 1.6 Health not elsewhere classified
2. Education	2.1 Preprimary and primary education 2.2 Secondary education 2.3 Postsecondary nontertiary education 2.4 Tertiary education 2.5 Education not definable by level 2.6 Subsidiary services to education 2.7 RandD education 2.8 Education not elsewhere classified
3. Social protection	3.1 Sickness and disability 3.2 Old age 3.3 Survivors 3.4 Family and children 3.5 Unemployment 3.6 Housing 3.7 Social exclusion n.e.c. 3.8 RandD Social protection 3.9 Social protection not elsewhere classified
4. Defense	4.1 Military defense 4.2 Civil defense 4.3 Foreign military aid 4.4 RandD defense 4.5 Defense not elsewhere classified

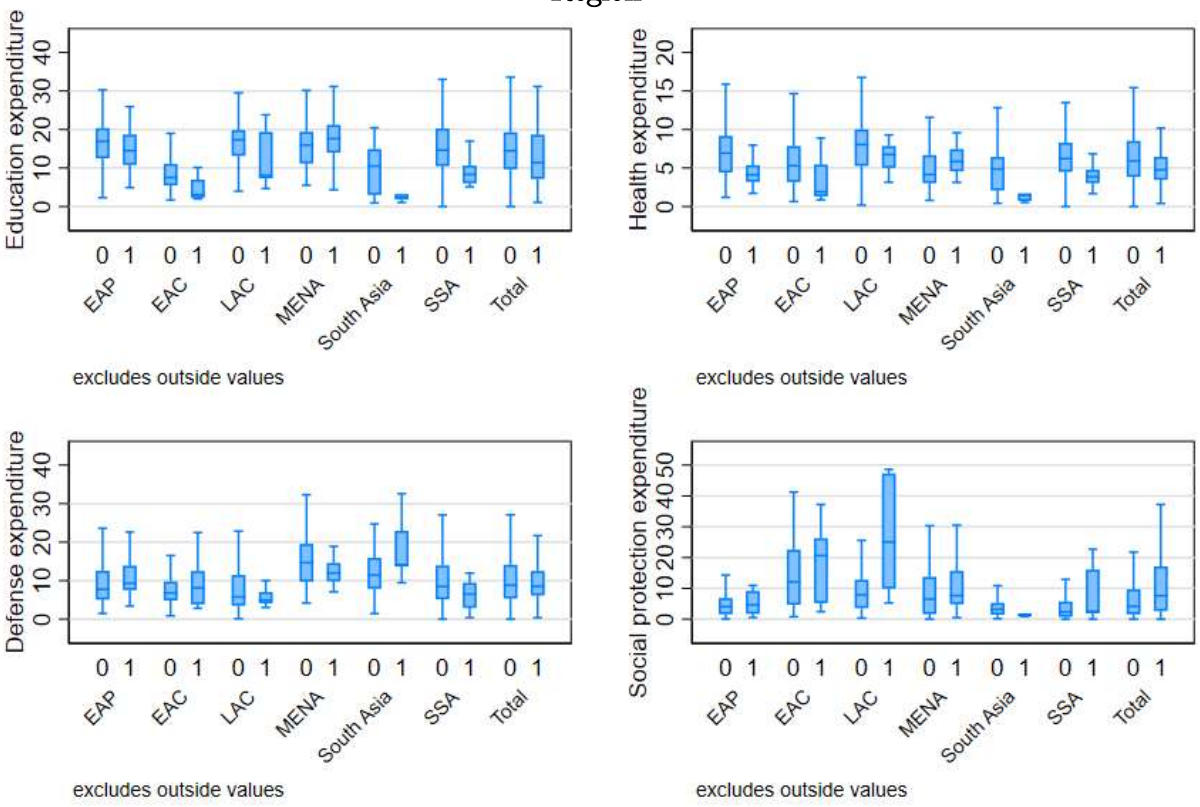
Appendix C: Definitions and sources of variables

Variables	Definitions	Sources
Education	percentage of education expenditure in total	International Food Policy Research Institute (IFPRI), 2013, "Statistics of public expenditure for economic development (SPEED)
Health	percentage of health expenditures in total	International Food Policy Research Institute (IFPRI), 2013, "Statistics of public expenditure for economic development (SPEED)
Defense	percentage of defense expenditure in total	International Food Policy Research Institute (IFPRI), 2013, "Statistics of public expenditure for economic development (SPEED)
Social protection	percentage of social protection expenditure	International Food Policy Research Institute (IFPRI), 2013, "Statistics of public expenditure for economic development (SPEED)
GDPt	GDP per capita (constant LCU)	World Development Indicators. The World Bank Group, 2015
ODA Gini	Net ODA received (% of GNI)	World Development Indicators. The World Bank Group, 2015
Remittances to GDP	Personal remittances received (% of GDP)	World Development Indicators. The World Bank Group, 2015
Rents	Total natural resources rents (% of GDP)	World Development Indicators. The World Bank Group, 2015
Executive elections	Dummy for presidential election	Cruz, Cesi, Philip Keefer and Carlos Scartascini (2018). "Database of Political Institutions 2017 (DPI2017)."Inter-American Development Bank. Numbers for Development.
Dependency ratio	Number of dependents aged zero to 14 and over the age of 65	World Development Indicators. The World Bank Group, 2015

Appendix D: Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
oil_gas_disc	2976	.053	.224	0	1
toteducati~p	1915	14.501	7.06	.01	49.049
tothealth_~p	1884	6.422	3.959	.004	32.776
totdefense~p	1713	11.184	9.916	.007	78.373
totsp_ppp	1816	7.317	8.208	0	49.436
lgdppc_LCU~t	2789	10.988	2.442	5.453	18.252
oda_gini	2553	7.534	9.945	-.643	94.946
fdi_inflows	2694	2.773	6.111	-28.624	161.824
remittance~p	2264	5.216	15.767	0	235.924
total_rents	2768	8.068	9.689	0	84.24
exelec_dpi	2773	.117	.321	0	1
pop_65	2966	4.664	2.683	1.871	18.079
area	2883	902000	2190000	298	1.71e+07
landlocked	2883	.247	.432	0	1

Appendix E: Sector expenditures (% of total spending) across treatment and control group by Region



Source: Author, based on IFPRI's Statistics on Public Expenditures for Economic Development (SPEED) database

Chapter 3: DO SOVEREIGN WEALTH FUNDS (SWFs) MATTER FOR A BETTER NON-RESOURCE TAX MOBILIZATION IN RESOURCE-RICH COUNTRIES?

1. Introduction

The improvement of domestic tax mobilization is one of the most important ongoing research issues, especially for developing countries. Indeed, we have just passed the crucial point of the end of Millennium Development Goals (MDGs) and adopted the post-2015 development program built on Sustainable Development Goals (SDGs). The global review of MDGs and the launch report of SDGs point out the necessity of identifying new sources of financing countries' development while enhancing the participation of recipient countries. The ninth forum for the development of Africa led to the so-called "*Consensus de Marrakech* ", where African countries have stressed the importance of a better mobilization of domestic revenues for their economic growth, by adopting recommendations, which are expected to gather more revenues especially tax revenues. This is an important point, especially since developing countries are essentially constituted of sub-Saharan African countries. This statement was preceded by the commitment of G20 countries in November(OECD, World Bank, 2011). In the aftermath of the international financial crisis, it was time to think about alternative ways to finance ongoing development in developing countries. They have identified recommendations to support the development of a more effective tax system in receiving countries that consist of actions on providing:

- technical assistance to encourage multinational enterprises transparency and compliance
- better tracking of results by improving the quality of statistics on tax systems.

In February 2016, the Managing Director of the International Monetary Fund, Christine Lagarde, pointed out the necessity for countries, mainly oil-exporting countries,[20] to gather more reliable revenues to face the downward oil price trend. '(...) these economies need to strengthen their fiscal frameworks and reengineer their tax systems by reducing their heavy reliance on oil revenues and by boosting non-hydrocarbon sources of revenues.' (Christine Lagarde, 2016). Therefore, it is clear that the issue of domestic tax effort is more than ever a key element for countries' economic

[20] It can easily be extended to all resources rich countries

development, especially for resource-rich countries. Studies have followed these recommendations in the economic literature

2. Literature review

One central economic paradox depicted in the past thirty years is that resource-abundant countries show relatively low economic growth rather than resource-poor ones. There seem to be a group of "growth losers" that cannot fully benefit from their wealth (Mehlum, Moene, & Torvik, 2006). Several resource-rich developing African countries like Nigeria, Sudan, and Mali have shared the same standards of living with the actual fast-growing economies of East Asia such as Singapore, Japan, and Korea, until the '70s, but then experienced quite different development patterns due to the reliance of the former on resource revenues.

Auty (1993) has introduced this confusing phenomenon in the literature as *a resource curse thesis*. The main reason for this curse is that resource revenues undermine the pursuit of sound policies. During boost cycles, governments of resource-rich countries remained too optimistic and undertook significant projects that have often been judged unnecessary; this leads to more than proportional expenditures. In subsequent years, things became more challenging to mobilize an adequate amount of reserves to offset potential fall in commodity prices. After the oil prices boom in 1973, many resource-rich countries gained a strong feeling of superpowers and built an import substitution growth strategy based on their current resource revenue. The system has worked relatively well until the early '80s, which corresponds to the mineral prices downturn. Besides the considerable cut-off in government revenues due to a significant decrease in exports earnings, developing resource-rich countries experience a severe term of trade shock. This idea was highlighted by the seminal work of Sachs & Warner (1995, 2001), which found an inverse relationship between resource intensity and economic growth, even though the econometrical technique used has been strongly criticized because of endogeneity problems. Hence, a wave of empirical studies has analyzed the negative impact of natural resources on economic growth, saving and investment, non-hydrocarbon revenues, and public capital stock. (Gylfason, 2001b,

Gylfason, 2006; Gylfason & Zoega, 2006; Bornhorst, Gupta, & Thornton, 2009; Boos & Holm-Müller, 2013; S. Bhattacharyya & Collier, 2014)

Collier, (2006) has established connexion between the consequences of the two unearned income, aid and resource revenues[21]. He kicked off the literature on aid conditionality by putting foreign aid in parallel with resource revenues. For the authors, the negative consequences of the heavy reliance on resources can be a "natural experiment" of a significant expansion of foreign aid. Indeed, he relayed that resource-rich governments gather few domestic revenues compared to non-resource rich countries mainly because they tax less. (Bornhorst et al., 2009) have shown empirical evidence that hydrocarbon revenues hinder the mobilization of hydrocarbon revenues. They found an offset of 0.2 percentage points of non-hydrocarbon payments. James (2015b) has also reached the same conclusion for United States that variations in resources revenues lowered non-resource ones, particularly income tax revenues, to about 12 percentage points. Crivelli & Gupta (2014a) were the first authors who assessed the impact of tax revenues on the components of all non-resource tax revenues. They confirmed the negative effect on total non-resource taxes and found an important offset on Value Added Tax (VAT) revenues and a smaller one for income and trade tax revenues.

To deal with the disincentive effect of resource revenues, we empirically tested the impact of Sovereign Wealth Funds (SWFs) on non-resource taxes in resource-rich countries. International Working Group of Sovereign Wealth Funds (IMF-IWG 2008) defined SWFs as [...] "*special purpose investment funds or arrangements owned by the general government. Created by the general government for macroeconomic purposes, SWFs hold, manage, or administer assets to achieve financial objectives and employ a set of investment strategies which include investing in foreign financial assets.*"

[21] The(WTO, 2010) World Trade Organization's report, defines natural resources as "*stocks of materials that exist in the natural environment that are both scarce and economically useful in production or consumption, either in their raw state or after a minimal amount of processing*". In this article, it covers especially non-renewable energy such as oil, coal, gas and minerals. Throughout the rest of the document we will use alternatively "resources" or "natural resources".

The SWFs are commonly established out of balance of payments surpluses, official foreign currency operations, the proceeds of privatizations, fiscal surpluses, or receipts resulting from commodity exports. The creation of SWFs was first proposed by Auty (1993). Van der Ploeg & Venables (2008) relaid it who suggested that stabilization funds help capital scarce economies smooth volatility induced by the fluctuations of commodity prices and enhance the non-resource economy's growth non-resource revenues. They modeled several situations depending on the level of development, capital scarcity since there is no unique response to the curse.

We decided to empirically analyze the impact of SWFs' creation on the mobilization of non-resources domestic revenues in such circumstances. The main channel is that creating a commodity fund tight the budget constraints and thus forces resource-rich countries' governments to have predictable resources. Moreover, creating a fund is a signal of a significant level of accountability for the government and encourages them to increase non-resource revenues to finance expenditures. The rest of the paper is organized as follows. Section 2 describes the empirical methodology and the dataset, section 3 shows econometrics results, and section 4 describes robustness checks. Section 5 concludes.

3. Data and methodology

3.1. Methodology

Our objective is to study the effect of the creation of SWF on non-resource taxes in resource-rich countries. To achieve that, we decided to use alternative propensity score matching methods since the adoption of SWF is not random and subject to self-selection bias (Heckman, J., Smith, 1995). Indeed, countries that decided to set up commodity funds did it to achieve sound budgetary positions to avoid boom-bust cycles or diversify their economy. Hence, the challenge is choosing an econometric framework that corrects this issue, and propensity score matching methods deal well with it. In addition, we are interested in calculating the Average Treatment effect on the Treated (ATT):

$$ATT = E[(Y_{i1} - Y_{i0})|SWF_i = 1] = E[Y_{i1}|SF_i = 1] - E[Y_{i0}|SWF_i = 1]$$[22] (1)

Let consider SWF_i as the dummy treatment variable, which is defined as above. We have two outcomes, Y_{i1} which is the observed resource taxes of country i when $SWF_i = 1$ and Y_{i0} the outcome of country i if it has not created a fund. It's important to note that $Y_{i0}|SWF_i = 1$ cannot be observed. It is a hypothetical situation and $E[Y_{i0}|SWF_i = 1]$ can be approximated by $E[Y_{i0}|SWF_i = 0]$ only in experimental studies but not here because of the problem of self-selection mentioned above. We use PSM developed by Rosenbaum & Rubin (1983) to solve this. They propose matching each treated country with a counterfactual belonging to the control group, which shares the same characteristics as the treatment group except having access to treatment. This method relies on a set of covariates X_i that influence simultaneously the treatment and outcomes, and ensure that "unconfoundedness assumption" Caliendo, Caliendo, & Kopeinig (2008) holds. This assumption provides that after controlling for the observable variables X_i, there are not some omitted variables that can affect treatment or control group: $Y_{i0}, Y_{i1} \perp SWF_i | X_i$. Thus $E[Y_{i0}|SF_i = 1, X_i]$ is equivalent to $E[Y_{i0}|SWF_i = 0, X_i]$ and the equation (1) can be rewritten as:

$$ATT = E[Y_{i1}|SWF_i = 1, X_i] - E[Y_{i0}|SWF_i = 0, X_i] \quad (2)$$

Another particularity of PSM is that it allows resuming the high dimension of covariates' vector to a single one given by X_i. It's the second assumption named "common support" which ensures that treated and untreated countries share the same probability $p(X) \subset (0,1)$ of being treated. We have thus $Y_{i0}, Y_{i1} \perp SWF_i | p(X_i)$, and ATT became:

$$ATT = E[Y_{i1}|SWF_i = 1, p(X_i)] - E[Y_{i0}|SWF_i = 0, p(X_i)] \quad (3)$$ where $p(X_i)$ represents propensity scores of each country i.

[22] For the total sample of Stabilization funds we have: $ATT = E[(Y_{i1} - Y_{i0})|SWF_i = 1] = E[Y_{i1}|SF_i = 1] = E[Y_{i0}|SF_i = 1]$

To ensure the reliability of our results, we implement different matching techniques. The main difference between these algorithms is the approach used to pair treated observations.

First, we choose the most-frequently-used method, N-nearest neighbors matching with replacement, where each treatment is matched to one (1-NNM), two (2-NNM), or three (3-NNM) non treated observations with the closest propensity score. Each control can be matched with more than one treated country.

Second, we use Radius Matching (RM) to prevent the fact that the distance between treated and non-treated can remain high with the NN matching method. RM method allows us to choose a threshold (here r= 1%, r=5%, or r= 10%) on maximum propensity score distance.

Third, we use Local Linear Regression Matching (LLRM), a non-parametric method used in Heckman, Ichimura, & Todd, (1997). It involves computing a counterfactual by utilizing a weighted average of non-treated observations. This method is similar to the fourth regression method we used, Kernel Matching (KM), given the former is also a non-parametric method. In the KM method, the closest observation receives the highest weight. The only difference between these two non-parametric methods is the weighting method.

2.1- Data

We study the effect of creating an SWF, especially a stabilization fund, on the mobilization of non-resource domestic revenue in resource-rich countries. We follow the definition of resource-rich countries given by International Monetary Fund (2012b): the country is rich in non-renewable resources when it "*has either natural resource revenue or exports at least 20% of total fiscal revenue and exports, respectively, over 2006–10 (average)*". We used 60 countries among the 63 countries identified in Macroeconomic Policy Frameworks for Resource-Rich Developing Countries (2012). We add Colombia because the country established a fund during the study period: 1980-2011 because of the availability of sovereign wealth fund data and disaggregated tax revenues. Kiribati, Kuwait, Nauru,

and Tuvalu also have such a fund but created them early before 1980. We were also obliged to drop these four countries due to data availability. Our control group may appear to be relatively small. This is why we consider a significant period to maximize the number of observations and thus the number of degrees of freedom.

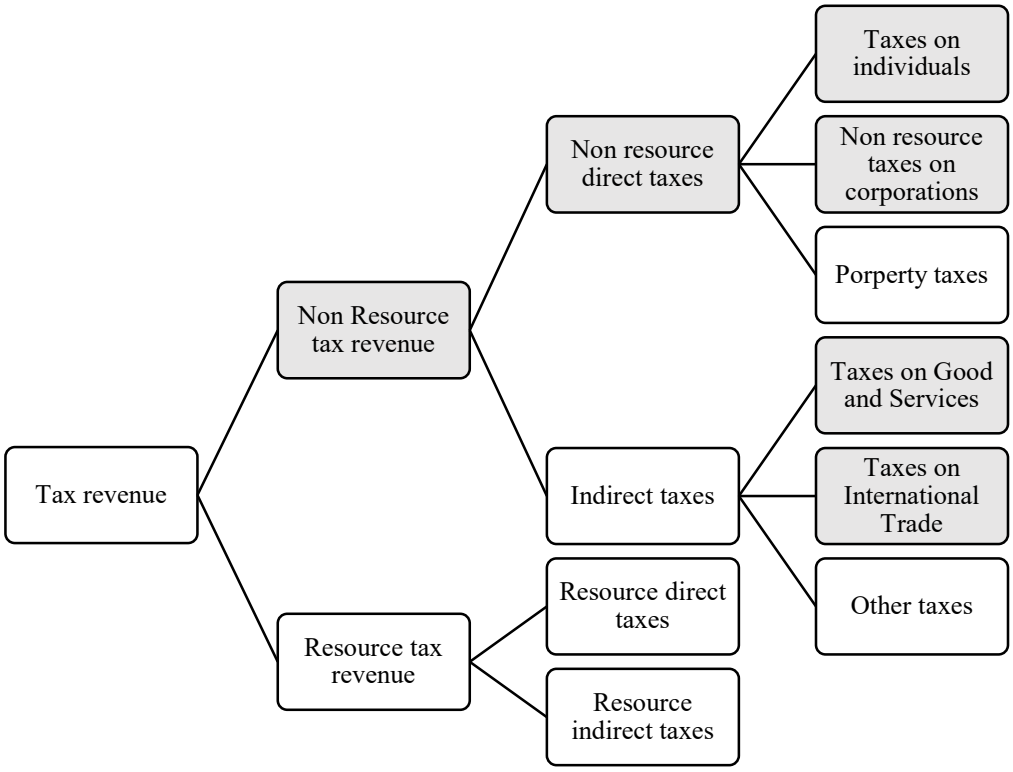
(i) The treatment variable

The treatment variable refers to Sovereign Wealth Fund (*SWF*) in general and Stabilization fund (SF), the main category of SWF. It is used to stabilize fiscal revenues in resource-rich countries by collecting a certain amount of resource revenues. To analyze the treatment effect, we use a binary variable *SWF* equal to one if the government is resource-rich and has established a Sovereign Wealth Fund between 1980-2011 and 0 if not. Nevertheless, we restrict this to the SFs[23] to see if our hypothesis still holds. Appendix A shows the localization of sovereign wealth funds included in this analysis.

[23] Except Pension Funds because they don't have an objective on overall fiscal revenues, and are just created to finance retirement system.

(ii) **The dependant variables :**For this study, we consider the global effect of SFs on non-resources total tax revenues and the heterogeneous effect of different types of non-tax revenues. Hence, in addition to non-resources total taxes to GDP (*TAX*), we add five variables: Corporates income taxes to GDP (*CIT*), Individual income taxes to GDP (*IIT*), total taxes on Good and Services to GDP (*TGS*), total Value-added taxes to GDP (*VAT*) and total trade taxes to GDP (*TRD*). All these data are calculated without resources revenues has organized as in Figure 1. We are just interested in colored boxes representing the main categories of government revenue, excluding extractive sectors' resources.

Figure 15: Classification of taxes revenue database

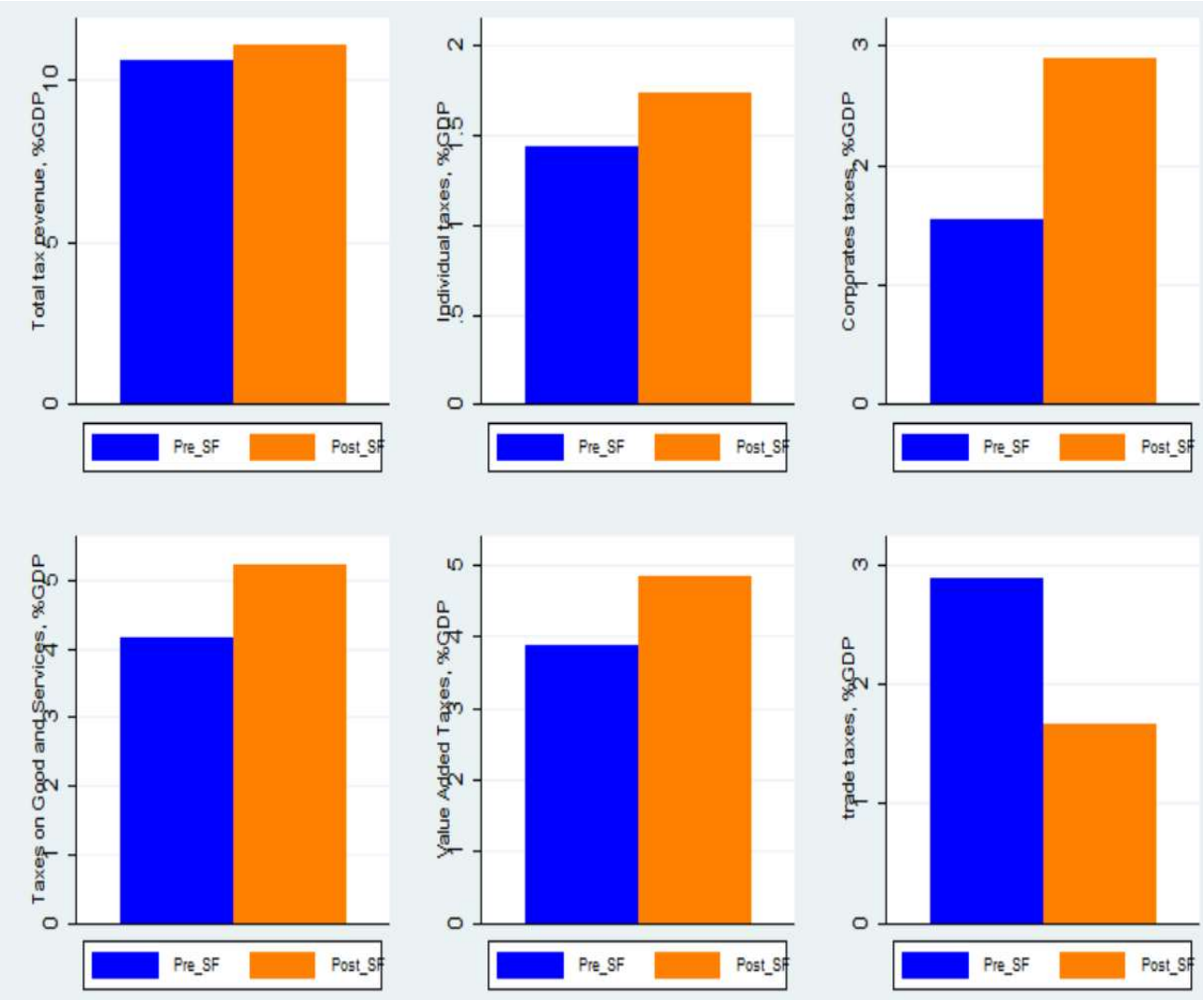


Source: ITCD government revenue dataset. Adapted from (Prichard, Cobham, & Goodall, 2014)

In Figure 2, we have insights into the effect of creating a sovereign wealth fund on the mobilization of domestic revenues; as we can see, for all types of taxes except international trade taxes, the level of non-resource revenues increases. The most significant evolution is corporate taxes, followed by taxes

on goods and services that contain value-added taxes. Only trade taxes shows a downward trend. We will give some explanation about it in the results section.

Figure 2: Non-resources taxes to GDP, Pre-SF vs. Post_SF



4. Results

4.1. Propensity score matching scores

We estimate the propensity scores using a probit model. Our baseline specification is close to that of Carpantier & Vermeulen, (2014). To measure the country's dependence on resource revenues,

we introduced mineral rents[24] (oil, gas, metals, and phosphates) to GDP. We also control for resources taxes to GDP to appreciate the government's capacity to gather fiscal revenues from the natural resources sector. We expect a positive impact on the creation of SF. Bornhorst et al. (2009) and Crivelli & Gupta (2014a) have shown that increased resources taxes induces fewer non-resources taxes. The link between resources taxes and our dependent variables is another reason to include this variable in the propensity score estimation.

We control for the country's development pattern by including the annual percentage growth rate of GDP. In addition, the country's integration in the global financial market can also be an essential determinant of creating a fund by opening new opportunities worldwide. For these reasons, we add total trade to GDP and international financial integration measured by the evolution of external assets and liabilities to GDP (Lane & Milesi-ferretti, 2007). As a result, the two variables are expected to impact the probability of creating a fund positively.

The evolution of total foreign reserves is an essential determinant of a country's ability to set up a fund. As is mentioned in the SWF definition, funds can be created based on foreign holdings (Aizenman & Glick, 2009). We also include the evolution of the dependency ratio to control for demographic factors. The expected sign here is negative. A country with a vital dependant population rather than a working population will have more social expenditures and then little fiscal flexibility to save some of its resource wealth in a fund. Finally, we add two institutional variables: *polity2* and the *quality of investment*. The former denotes whether the country belongs to an autocratic (-10) or democratic (10) regime. We keep it as it is, without any transformation, to take advantage of the

[24] We address the issue of mineral rent's endogeneity in the robustness section. It is worth to notice that natural resource dependence is different from natural resource abundance. The former measure to what extent country relies on natural resources, hence the country can be resource abundant like Norway but not resource dependant because of the diversification of the economy. The dependence on natural resources has been measured in the literature by natural resource rents (Sambit Bhattacharyya & Hodler, 2014)), primary exports over GDP as in ((J. D. Sachs & Warner, 1995b); (Arezki & van der Ploeg, 2011), natural capital in natural wealth (Gylfason, 2001c); (Gylfason & Zoega, 2006) and share of mineral exports (Dietz, Neumayer, & Soysa, 2007). As for the abundance of natural resources it has been measured by the total of subsoil wealth (Brunnschweiler & Bulte, 2008b)

precision of data. The country's investment profile is measured on a scale of one to four; it is a good proxy of the strength of government. When we suppose that there are significant risks of expropriation or difficulties in profits repatriation, in that case, investors will not invest both in natural resource and non-resource activities, which implies low resources to put in a fund and low non-resource taxes.

Unsurprisingly, the statistically significant results meet our expectations. The explanatory power of the model at just less than 50% is entirely satisfactory. As we can see, resources taxes, the evolution of foreign reserves, and mineral rents positively influence creating a fund. Countries with high growth rates are more likely to make a fund. We notice that developing countries face more difficulties managing their resource wealth and escaping from the so-called "resource curse." As a result, there are more likely to establish these funds. Democratic countries appear to have a greater probability of setting up a fund during this period, which means that government accountability matters for creating a commodity fund. We have a comparable result with the quality of investment even if this variable is only significant in the baseline results (column 9). This outcome is relative to the fact that it is necessary to have sound investment policies to attract investors in the natural resources sector, which increases the number of revenues directed into commodity funds. Trade openness is the only variable that is not significant on our baseline specification. However, we keep it because it is important to capture the integration of the country on the global market and thus its ability to export natural resources abroad. The last three columns show some robustness specifications. We will focus on the robustness section.

Table 1: Propensity score results

VARIABLES	(1) swf	(2) swf	(3) swf	(4) swf	(5) swf	(6) swf	(7) swf	(8) swf	(9) swf	rob-1 swf	rob-2 swf	rob-3 swf
Resources taxes	0.0684***	0.0657***	0.0652***	0.0575***	0.0436***	0.0525***	0.0508***	0.0330***	0.0322**	0.0430*	0.0491*	0.0487*
	(0.00857)	(0.00869)	(0.00876)	(0.00914)	(0.00956)	(0.0102)	(0.0104)	(0.0124)	(0.0147)	(0.0254)	(0.0262)	(0.0262)
GDP growth		0.0158***	0.0205***	0.0147**	0.0195*	0.0179	0.0179	0.0189*	0.00917	0.000897	0.000663	0.000680
		(0.00604)	(0.00665)	(0.00681)	(0.0100)	(0.0117)	(0.0117)	(0.0114)	(0.0172)	(0.0189)	(0.0192)	(0.0191)
Financial integration			0.0154	0.00247	0.0166	0.0198	0.0170	0.0309*	0.0471*	0.0686***	0.0749***	0.0737***
			(0.0122)	(0.0128)	(0.0130)	(0.0159)	(0.0163)	(0.0183)	(0.0244)	(0.0265)	(0.0267)	(0.0272)
Mineral rents				0.0165***	0.0149***	0.0228***	0.0230***	0.0293***	0.0289***	0.0342***	0.0325***	0.0326***
				(0.00264)	(0.00315)	(0.00378)	(0.00379)	(0.00458)	(0.00601)	(0.00739)	(0.00754)	(0.00755)
Total reserves growth					0.344***	0.421***	0.412***	0.374***	0.553***	0.557***	0.609***	0.609***
					(0.0266)	(0.0327)	(0.0337)	(0.0354)	(0.0566)	(0.0633)	(0.0665)	(0.0666)
Trade openness						-0.00261	-0.00249	-0.00244	-0.00320	-0.00594	-0.00554	-0.00545
						(0.00218)	(0.00220)	(0.00226)	(0.00382)	(0.00486)	(0.00473)	(0.00475)
Dependency ratio growth							-0.132	-0.185	-0.581***	-0.505***	-0.617***	-0.617***
							(0.122)	(0.125)	(0.159)	(0.165)	(0.174)	(0.174)
Polity2								0.0561***	0.0786***	0.0986***	0.107***	0.106***
								(0.0117)	(0.0152)	(0.0178)	(0.0185)	(0.0193)
Quality of the investment									0.0664*	0.0458	0.0178	0.0208
									(0.0346)	(0.0370)	(0.0384)	(0.0407)
5 years Lag- Resources taxes										0.00943	0.00273	0.00315
										(0.0229)	(0.0235)	(0.0235)
Inflation											0.00295***	0.00298***
											(0.000762)	(0.000773)
Government Stability												-0.0114
												(0.0507)
Observations	1,312	1,224	1,206	1,171	1,100	1,068	1,068	1,049	854	736	718	718
Pseudo R2	0.0542	0.0570	0.0615	0.0943	0.296	0.369	0.370	0.375	0.478	0.493	0.504	0.504

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.2. ATT results for non-resource tax revenues

In this section, we comment on the results of table 2. Each column represents the matching methods listed above, using estimated propensity scores. Irrespective of the methods, the impact of having a sovereign wealth fund increases global non-resource tax revenues from 1.03% to 4.31% of GDP in resource-rich countries. This effect can be explained by creating such a fund that impacts the government's fiscal revenue. Indeed, it implies that the government has to raise a certain amount of resource wealth to feed the commodity fund, and the consequence is a shortfall in government revenues. To counterbalance this apparent loss, a better tax collection system is needed. For example, the government of Botswana has stated this objective for the Pula Fund: "*Botswana seeks to ensure that current spending is only financed with non-resource revenues. Resource revenues are either used to finance investment (including human capital) or saved in the Pula Fund".* This objective implies that non-resource revenues must be better collected, a well-designed tax mobilization strategy, and non-resource activities promotion.

The second explanation is that creating a fund is a signal that the country gives its financial partners that it undertakes significant changes in its fiscal policies to avoid adverse effects due to natural resource windfall. The case of Chad in 2005 is the most striking example of what is being said. The country had an agreement with World Bank that it would receive loans to develop a pipeline. In return, the government committed to set up an oil fund, monitored by an independent body. Unfortunately, this story has a bad ending because the Chadian government ran afoul of the agreement but is very illustrative of the signal given to the international community.

This signal is also associated with reforms that reduce sovereign notation and thus mobilize fiscal revenues without high premiums, which can be reinvested in non-resource domestic activities. The number of sovereign wealth funds in countries that Moody's rates have more than doubled over the past 15 years. As of 2014, the twenty-six globally invested sovereign wealth funds had $4.5 trillion of assets under management, about twice the size of hedge funds and nearly half global foreign exchange

reserves. As sovereign wealth funds are largely unleveraged, their assets provide a sizeable buffer against commodity shocks. As a result of their sizeable reserves, sovereign wealth funds are helping to support domestic fiscal credit profiles, acting as a buffer to the commodity price shocks and improving external stability and debt sustainability. One of the main objectives of resource-rich countries by setting a commodity fund is to promote growth by diversifying their economy. Hence, interests generated by the sovereign fund investments are injected into non-resource sectors, public infrastructures, or transfers, allowing more taxation revenues.

In the following sub-section, we will desegregate this global effect to see the impact on different non-resources taxes.

Table 2: Matching results for non-resource taxes

TV: Sovereign wealth fund ATT	1- Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	4.674	4.308**	4.052**	0.369	0.194	0.125	0.148	0.133
	(2.917)	(1.918)	(1.579)	(0.489)	(0.492)	(0.487)	(0.490)	(0.484)
[2]Adding GDP growth	0.272	0.377	0.335	0.695	0.585	0.166	0.206	0.173
	(0.646)	(0.589)	(0.576)	(0.536)	(0.527)	(0.495)	(0.477)	(0.492)
[3] Adding financial integration	0.434	-0.0867	0.166	0.839	0.646	0.248	0.372	0.261
	(0.614)	(0.604)	(0.596)	(0.551)	(0.513)	(0.479)	(0.500)	(0.477)
[4] Adding natural resources rents	1.737**	1.338**	1.138*	1.372***	1.278**	1.031**	1.044**	1.019**
	(0.706)	(0.651)	(0.602)	(0.526)	(0.524)	(0.498)	(0.505)	(0.503)
[5] Adding reserves growth	2.595***	2.394***	2.658***	2.631***	2.276***	2.592***	2.671***	2.555***
	(0.709)	(0.655)	(0.649)	(0.694)	(0.585)	(0.546)	(0.518)	(0.533)
[6] Adding trade openness	2.261***	2.556***	2.588***	2.373***	2.509***	2.817***	2.891***	2.798***
	(0.725)	(0.672)	(0.618)	(0.730)	(0.635)	(0.542)	(0.518)	(0.510)
[7] Adding dependency ratio growth	2.728***	2.799***	2.783***	2.500***	2.771***	2.790***	2.838***	2.769***
	(0.692)	(0.687)	(0.608)	(0.720)	(0.602)	(0.530)	(0.548)	(0.553)
[8] Adding polity2	2.267***	1.876**	1.871***	1.876**	1.963***	2.345***	2.427***	2.317***
	(0.879)	(0.840)	(0.706)	(0.817)	(0.723)	(0.628)	(0.610)	(0.610)
[9] Adding quality of investment	2.607***	2.470***	2.616***	1.496	1.946**	2.548***	2.688***	2.519***
	(0.928)	(0.895)	(0.837)	(0.957)	(0.850)	(0.760)	(0.728)	(0.739)
Number of treated observations	138	138	138	102	124	138	138	138
Number of control observations	689	689	689	689	689	689	689	689
Number of observations	827	827	827	791	813	827	827	827

Bootstrapped standard errors in parenthesis obtained through 500 replications. *, **, ***, denote respectively a significance level of 10%, 5% and 1%

4.3. Heterogeneity of impact of SF on non-resource taxes

As in Crivelli & Gupta (2014a), we desegregate the global ATT to assess the impact of sovereign wealth funds on non-resource taxes subcategories. The results are reported in table 3 to table 7 hereafter. We have four types of non-resources, as mentioned above. We also add the total direct non-resources taxes results to capture the global effect on both non-resources corporates taxes and individual taxes. Table 3 shows a statistically significant and positive impact of sovereign wealth funds at almost 1%.

We must notice that the number of observations drops drastically; this sometimes implies a loss of significance. But globally, the positive effect of sovereign wealth funds on non-resource taxes remains. Non-resources corporate taxes, non-resources individual taxes, non-resources good and services taxes, and non-resources value-added taxes are significantly and positively impacted by the treatment, except international trade tax revenues, which are negatively impacted. This is in line with our expectations because implementing a sovereign wealth fund is associated with promoting the country's openness.

In addition, it can explain the drop of some international taxes, leading to losses in non-resource tax revenues. However, these are relatively low compared with the overall gain.

Abadie, A., Imbens (2006) criticized bootstrap estimators because they do not provide reliable standard error; we thus use Abadie, A., Imbens (2015) method to correct standard errors. The results for types of taxes are presented in table 9. It corroborates previous results, with a much better level of significance for all non-resource except trade taxes. We perform many other robustness checks, like keeping only oil countries, dropping the years after 2007 to ignore the economic crisis. The results remain.

Table 3: Matching results for non-resources direct taxes

TV: Sovereign wealth fund ATT	1- Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	2.426**	2.295***	2.236***	0.937***	0.808***	0.813***	0.835***	0.805***
	(1.208)	(0.868)	(0.717)	(0.289)	(0.304)	(0.272)	(0.265)	(0.259)
[2]Adding GDP growth	0.925***	1.110***	0.976***	1.240***	1.143***	0.882***	0.868***	0.892***
	(0.358)	(0.352)	(0.334)	(0.333)	(0.316)	(0.272)	(0.284)	(0.278)
[3] Adding financial integration	1.250***	1.099***	1.078***	1.260***	1.207***	0.920***	0.966***	0.938***
	(0.359)	(0.356)	(0.340)	(0.322)	(0.299)	(0.280)	(0.284)	(0.271)
[4] Adding natural resources rents	1.142***	1.163***	1.190***	1.355***	1.180***	1.125***	1.146***	1.130***
	(0.405)	(0.388)	(0.364)	(0.325)	(0.334)	(0.316)	(0.293)	(0.291)
[5] Adding reserves growth	1.940***	1.773***	1.656***	1.726***	1.518***	1.582***	1.639***	1.575***
	(0.456)	(0.434)	(0.436)	(0.432)	(0.420)	(0.403)	(0.395)	(0.385)
[6] Adding trade openness	2.116***	1.919***	1.852***	1.765***	1.827***	1.838***	1.939***	1.890***
	(0.396)	(0.361)	(0.362)	(0.469)	(0.384)	(0.335)	(0.316)	(0.298)
[7] Adding dependency ratio growth	1.821***	1.905***	1.847***	1.485***	1.787***	1.834***	1.940***	1.888***
	(0.378)	(0.356)	(0.355)	(0.455)	(0.377)	(0.348)	(0.332)	(0.326)
[8] Adding polity2	2.113***	1.956***	2.006***	1.264**	1.400***	1.949***	2.012***	1.954***
	(0.535)	(0.514)	(0.481)	(0.519)	(0.454)	(0.455)	(0.442)	(0.432)
[9] Adding quality of investment	1.698**	1.746**	1.754***	0.631	0.822*	1.830***	1.803***	1.820***
	(0.730)	(0.678)	(0.649)	(0.572)	(0.496)	(0.615)	(0.610)	(0.655)
Number of treated observations	120	120	120	65	85	120	120	120
Number of control observations	574	574	574	574	574	574	574	574
Number of observations	694	694	694	639	659	694	694	694

Table 4: Matching results for non-resources individual taxes

TV: Sovereign wealth fund ATT	1-Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	1.040	0.955	0.978*	0.378*	0.288	0.276*	0.276*	0.296*
	(0.925)	(0.614)	(0.514)	(0.196)	(0.198)	(0.159)	(0.164)	(0.164)
[2]Adding GDP growth	0.190	0.229	0.137	0.293	0.297	0.165	0.159	0.181
	(0.263)	(0.234)	(0.221)	(0.221)	(0.209)	(0.174)	(0.176)	(0.179)
[3] Adding financial integration	0.0202	0.0977	0.110	0.306	0.278	0.260	0.0556	0.208
	(0.269)	(0.247)	(0.222)	(0.208)	(0.191)	(0.172)	(0.179)	(0.177)
[4] Adding natural resources rents	0.195	0.133	0.105	0.364	0.266	0.146	0.0925	0.150
	(0.284)	(0.261)	(0.265)	(0.231)	(0.238)	(0.216)	(0.204)	(0.211)
[5] Adding reserves growth	0.556*	0.533*	0.561**	0.449	0.560**	0.655***	0.661***	0.620***
	(0.293)	(0.280)	(0.254)	(0.285)	(0.251)	(0.236)	(0.229)	(0.224)
[6] Adding trade openness	0.795***	0.879***	0.920***	0.814**	0.906***	0.876***	0.919***	0.879***
	(0.256)	(0.255)	(0.243)	(0.358)	(0.289)	(0.236)	(0.216)	(0.222)
[7] Adding dependency ratio growth	0.845***	0.998***	1.013***	0.716**	0.940***	0.978***	0.964***	0.978***
	(0.248)	(0.250)	(0.228)	(0.361)	(0.340)	(0.224)	(0.217)	(0.220)
[8] Adding polity2	1.021***	0.982***	0.989***	0.692*	0.859**	0.940***	0.960***	0.953***
	(0.366)	(0.336)	(0.332)	(0.384)	(0.351)	(0.279)	(0.316)	(0.288)
[9] Adding quality of investment	1.221***	1.160***	1.085***	0.946	1.029**	1.185***	1.130***	1.172***
	(0.315)	(0.338)	(0.298)	(0.602)	(0.455)	(0.277)	(0.259)	(0.266)
Number of treated observations	30	30	30	20	23	30	30	30
Number of control observations	363	363	363	363	363	363	363	363
Number of observations	393	393	393	393	386	393	393	393

Bootstrapped standard errors in parenthesis obtained through 500 replications. *, **, ***, denote respectively a significance level of 10%, 5% and 1%

Table 5: Matching results for non-resources corporate taxes

TV: Sovereign wealth fund ATT	1- Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	2.122**	1.998***	2.031***	1.331***	1.186***	1.155***	1.144***	1.156***
	(1.001)	(0.740)	(0.650)	(0.353)	(0.346)	(0.322)	(0.320)	(0.338)
[2]Adding GDP growth	1.021***	0.967***	0.936**	1.406***	1.220***	1.033***	1.023***	1.027***
	(0.376)	(0.364)	(0.368)	(0.380)	(0.362)	(0.330)	(0.329)	(0.332)
[3] Adding financial integration	1.343***	1.192***	1.130***	1.385***	1.278***	1.168***	1.071***	1.141***
	(0.387)	(0.356)	(0.373)	(0.383)	(0.347)	(0.334)	(0.339)	(0.314)
[4] Adding natural resources rents	1.162***	1.258***	1.211***	1.590***	1.485***	1.499***	1.248***	1.494***
	(0.394)	(0.401)	(0.405)	(0.381)	(0.376)	(0.346)	(0.348)	(0.340)
[5] Adding reserves growth	0.924	1.052*	1.145**	1.267**	1.339**	1.089**	1.112**	1.098**
	(0.588)	(0.545)	(0.568)	(0.563)	(0.546)	(0.504)	(0.498)	(0.473)
[6] Adding trade openness	1.777***	1.833***	1.815***	0.617	0.969*	1.713***	1.708***	1.711***
	(0.575)	(0.544)	(0.482)	(0.636)	(0.583)	(0.523)	(0.485)	(0.474)
[7] Adding dependency ratio growth	1.502**	1.696***	1.830***	0.385	1.027*	1.685***	1.703***	1.690***
	(0.590)	(0.519)	(0.569)	(0.669)	(0.578)	(0.520)	(0.508)	(0.536)
[8] Adding polity2	0.525	0.730	0.708	0.125	0.432	0.618	0.649	0.630
	(0.875)	(0.811)	(0.840)	(0.582)	(0.553)	(0.690)	(0.797)	(0.709)
[9] Adding quality of investment	-0.321	0.0882	0.318	0.0640	-0.282	-0.0873	0.0987	0.134
	(0.609)	(0.546)	(0.480)	(0.832)	(0.651)	(0.480)	(0.445)	(0.463)
Number of treated observations	34	34	34	17	21	32	34	34
Number of control observations	369	369	369	369	369	369	369	369
Number of observations	403	403	403	386	390	401	403	403

Bootstrapped standard errors in parenthesis obtained through 500 replications. *, **, ***, denote respectively a significance level of 10%, 5% and 1%

Table 6: Matching results for non-resources good and services taxes

TV: Sovereign wealth fund ATT	1-Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	3.511**	3.310***	3.286***	1.365***	1.316***	1.288***	1.313***	1.293***
	(1.570)	(1.093)	(0.952)	(0.308)	(0.290)	(0.296)	(0.293)	(0.300)
[2]Adding GDP growth	1.135***	1.257***	1.257***	1.409***	1.266***	1.185***	1.257***	1.182***
	(0.386)	(0.350)	(0.351)	(0.335)	(0.334)	(0.278)	(0.288)	(0.286)
[3] Adding financial integration	1.217***	1.111***	1.139***	1.399***	1.302***	1.208***	1.320***	1.203***
	(0.415)	(0.355)	(0.348)	(0.324)	(0.316)	(0.313)	(0.296)	(0.285)
[4] Adding natural resources rents	1.550***	1.310***	1.270***	1.554***	1.353***	1.256***	1.364***	1.249***
	(0.438)	(0.409)	(0.401)	(0.339)	(0.351)	(0.314)	(0.313)	(0.294)
[5] Adding reserves growth	2.315***	1.885***	1.639***	1.281**	1.627***	1.662***	1.775***	1.698***
	(0.563)	(0.480)	(0.497)	(0.550)	(0.471)	(0.383)	(0.393)	(0.385)
[6] Adding trade openness	1.588***	1.561***	1.432***	1.078*	1.301**	1.779***	1.798***	1.757***
	(0.547)	(0.559)	(0.510)	(0.642)	(0.601)	(0.407)	(0.395)	(0.423)
[7] Adding dependency ratio growth	1.442**	1.563***	1.547***	0.969	1.432***	1.706***	1.730***	1.699***
	(0.612)	(0.597)	(0.523)	(0.646)	(0.505)	(0.445)	(0.424)	(0.430)
[8] Adding polity2	1.322*	1.423**	1.135*	0.0934	0.737	1.073*	1.222**	1.067*
	(0.768)	(0.681)	(0.650)	(0.686)	(0.617)	(0.557)	(0.563)	(0.580)
[9] Adding quality of investment	-0.614	-0.264	-0.428	-0.870	-0.341	-0.0997	0.0778	-0.130
	(0.931)	(0.798)	(0.746)	(0.804)	(0.732)	(0.681)	(0.605)	(0.654)
Number of treated observations	98	98	98	72	88	98	98	98
Number of control observations	561	561	561	561	561	561	561	561
Number of observations	659	659	659	633	649	659	659	659

Bootstrapped standard errors in parenthesis obtained through 500 replications. *, **, ***, denote respectively a significance level of 10%, 5% and 1%

Table 7: Matching results for non-resources value-added tax revenues

TV: Sovereign wealth fund ATT	1- Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	-1.821	-1.238	-0.712	1.226***	1.295***	1.397***	1.260***	1.375***
	(1.481)	(1.008)	(0.812)	(0.378)	(0.352)	(0.288)	(0.286)	(0.311)
[2]Adding GDP growth	0.781*	1.096**	1.115***	1.486***	1.482***	1.456***	1.417***	1.450***
	(0.470)	(0.450)	(0.370)	(0.441)	(0.373)	(0.307)	(0.342)	(0.338)
[3] Adding financial integration	1.369***	1.307***	1.108***	1.366***	1.375***	1.470***	1.406***	1.475***
	(0.454)	(0.442)	(0.421)	(0.499)	(0.403)	(0.334)	(0.328)	(0.326)
[4] Adding natural resources rents	1.696***	1.548***	1.246***	1.513***	1.369***	1.514***	1.451***	1.469***
	(0.437)	(0.407)	(0.370)	(0.463)	(0.382)	(0.296)	(0.314)	(0.314)
[5] Adding reserves growth	1.496***	1.339***	1.352***	1.509*	1.549***	1.252***	1.203***	1.253***
	(0.410)	(0.366)	(0.313)	(0.778)	(0.541)	(0.315)	(0.306)	(0.311)
[6] Adding trade openness	1.079***	1.074***	1.164***	0.803	0.868	1.130***	1.071***	1.137***
	(0.391)	(0.380)	(0.335)	(0.751)	(0.544)	(0.340)	(0.321)	(0.339)
[7] Adding dependency ratio growth	1.481***	1.535***	1.249***	0.922	1.194*	1.220***	1.206***	1.250***
	(0.431)	(0.383)	(0.362)	(0.886)	(0.645)	(0.340)	(0.315)	(0.369)
[8] Adding polity2	1.691***	1.705***	1.672***	2.101*	2.010**	1.641***	1.570***	1.623***
	(0.517)	(0.441)	(0.433)	(1.214)	(0.906)	(0.443)	(0.405)	(0.419)
[9] Adding quality of investment	1.187*	1.557***	1.401**	2.022	1.341	1.040	1.320**	1.384**
	(0.666)	(0.595)	(0.550)	(1.841)	(1.258)	(0.647)	(0.525)	(0.580)
Number of treated observations	29	29	29	8	11	26	29	28
Number of control observations	122	122	122	122	122	122	122	122
Number of observations	151	151	151	130	133	148	151	150

Bootstrapped standard errors in parenthesis obtained through 500 replications. *, **, ***, denote respectively a significance level of 10%, 5% and 1%

Table 8: Matching results for non-resources international trade tax revenues

TV: Sovereign wealth fund ATT	1-Nearest Neighbor Matching	2- Nearest Neighbor Matching	3- Nearest Neighbor Matching	Radius Matching (r=0.005)	Radius Matching (r=0.01)	Radius Matching (r=0.05)	Local Linear Matching	Kernel Matching
[1] Adding Resources taxes	-0.928	-1.099	-1.257*	-1.205***	-1.235***	-1.307***	-1.341***	-1.315***
	(1.156)	(0.869)	(0.693)	(0.202)	(0.206)	(0.204)	(0.187)	(0.190)
[2]Adding GDP growth	-1.267***	-1.183***	-1.168***	-0.930***	-1.068***	-1.260***	-1.205***	-1.259***
	(0.271)	(0.248)	(0.248)	(0.211)	(0.199)	(0.200)	(0.211)	(0.216)
[3] Adding financial integration	-1.094***	-1.063***	-1.189***	-1.019***	-1.072***	-1.192***	-1.209***	-1.211***
	(0.284)	(0.288)	(0.249)	(0.209)	(0.209)	(0.216)	(0.210)	(0.216)
[4] Adding natural resources rents	-0.880***	-0.803***	-0.856***	-0.861***	-0.800***	-0.900***	-0.950***	-0.903***
	(0.293)	(0.270)	(0.264)	(0.243)	(0.220)	(0.205)	(0.206)	(0.198)
[5] Adding reserves growth	-0.238	-0.284	-0.221	-0.218	-0.386	-0.336	-0.350	-0.332
	(0.341)	(0.332)	(0.312)	(0.358)	(0.321)	(0.261)	(0.240)	(0.266)
[6] Adding trade openness	-0.221	-0.243	-0.293	-0.160	-0.311	-0.329	-0.303	-0.323
	(0.342)	(0.330)	(0.278)	(0.376)	(0.329)	(0.240)	(0.230)	(0.255)
[7] Adding dependency ratio growth	-0.0943	-0.261	-0.236	-0.170	-0.269	-0.334	-0.298	-0.334
	(0.325)	(0.288)	(0.305)	(0.372)	(0.314)	(0.239)	(0.229)	(0.236)
[8] Adding polity2	-0.173	0.0204	0.113	-0.0223	0.140	0.0171	0.0492	0.0300
	(0.316)	(0.261)	(0.273)	(0.358)	(0.298)	(0.212)	(0.210)	(0.222)
[9] Adding quality of investment	0.368	0.194	0.200	0.427	0.232	0.242	0.284	0.234
	(0.352)	(0.356)	(0.326)	(0.441)	(0.385)	(0.293)	(0.286)	(0.319)
Number of treated observations	125	125	125	78	96	125	125	125
Number of control observations	570	570	570	570	570	570	570	570
Number of observations	695	695	695	648	666	695	695	695

Bootstrapped standard errors in parenthesis obtained through 500 replications. *, **, ***, denote respectively a significance level of 10%, 5% and 1%

5.1. Treat for standard errors Abadie and Imbens (2015)

Table 9: Matching results for all types of non-resources taxes, after standard errors correction

Treatment Variable: Stabilization fund	Non-resources tax revenues	Non-resources corporates taxes	Non-resources individual taxes	Non-resources direct taxes	Non-resources good and services taxes	Non-resources VAT taxes	Non-resources international trade taxes
(ATT) Resources taxes	1.157**	1.744***	0.515**	1.275***	1.666***	0.773***	-1.043***
	(0.541)	(0.367)	(0.222)	(0.306)	(0.316)	(0.266)	(0.243)
GDP growth	1.237**	1.588***	0.477*	1.203***	1.602***	0.773*	-1.389***
	(0.561)	(0.428)	(0.254)	(0.345)	(0.405)	(0.441)	(0.250)
financial integration	1.194*	1.749***	0.496**	1.233***	1.404***	1.453***	-1.086***
	(0.668)	(0.423)	(0.208)	(0.364)	(0.378)	(0.350)	(0.254)
total natural resources rents	1.312**	1.931***	0.501**	1.547***	1.636***	1.049***	-1.188***
	(0.584)	(0.411)	(0.244)	(0.360)	(0.378)	(0.302)	(0.245)
total reserves growth	3.337***	2.059***	1.488***	2.584***	2.219***	1.137***	0.186
	(0.648)	(0.439)	(0.283)	(0.396)	(0.430)	(0.312)	(0.205)
trade openness	3.885***	2.098***	1.306***	2.275***	2.461***	0.997***	0.115
	(0.596)	(0.476)	(0.269)	(0.386)	(0.433)	(0.371)	(0.204)
dependency ratio growth	3.221***	1.864***	1.576***	2.097***	1.681***	1.686***	0.197
	(0.688)	(0.512)	(0.259)	(0.370)	(0.585)	(0.280)	(0.206)
polity2	2.602***	2.225***	1.361***	1.948***	1.306***	1.778***	0.140
	(0.820)	(0.458)	(0.225)	(0.405)	(0.458)	(0.318)	(0.187)
quality of the investment	3.060***	1.921***	1.170***	2.436***	1.485***	2.634***	0.111
	(0.969)	(0.471)	(0.210)	(0.405)	(0.558)	(0.447)	(0.269)
Number of treated observations	138	34	30	120	98	29	125
Number of control observations	689	369	363	574	561	122	570
Number of observations	827	403	393	694	659	151	695

5.2. Results for oil-exporting countries with oil proven reserves

Table 10: Matching results for all types of non-resources taxes after replacing mineral rents with oil reserves

Treatment Variable: Stabilization fund	Non-resources tax revenues	Non-resources corporates taxes	Non-resources individual taxes	Non-resources direct taxes	Non-resources good and services taxes	Non-resources VAT taxes	Non-resources international trade taxes
(ATT) Resources taxes	0.401	1.148***	0.317	1.015***	1.112***	1.418***	-1.154***
	(0.86)	(3.73)	(1.63)	(3.75)	(3.97)	(5.29)	(-5.19)
GDP growth	-0.0997	1.023***	0.226	1.067***	1.104***	1.472***	-1.120***
	(-0.19)	(3.00)	(1.07)	(3.46)	(3.43)	(3.56)	(-4.72)
financial integration	0.0525	1.178***	0.185	1.145***	0.873**	2.153***	-1.165***
	(0.10)	(3.70)	(0.87)	(3.61)	(2.44)	(6.95)	(-4.58)
total natural resources rents	0.891	1.263***	-0.134	1.094***	1.358***	2.066***	-0.698***
	(1.54)	(3.06)	(-0.55)	(3.20)	(3.87)	(5.83)	(-2.94)
total reserves growth	2.696***	1.417***	1.130***	1.575***	2.079***	0.355	-0.216
	(4.73)	(4.29)	(5.54)	(4.02)	(4.49)	(1.14)	(-0.87)
trade openness	3.042***	1.586***	1.080***	1.912***	2.146***	0.902***	-0.126
	(6.06)	(4.04)	(5.33)	(5.99)	(4.42)	(3.55)	(-0.58)
dependency ratio growth	2.953***	1.450***	0.843***	1.569***	2.123***	0.694**	-0.0649
	(5.29)	(3.58)	(4.06)	(4.67)	(4.73)	(2.16)	(-0.22)
polity2	3.637***	1.486**	1.090***	2.064***	2.131***	0.929	0.255
	(5.19)	(2.23)	(6.12)	(5.23)	(5.42)	(0.81)	(0.98)
quality of the investment	2.651***	1.318***	0.954***	2.455***	2.945***	-0.795	-0.592***
	(2.81)	(2.97)	(5.36)	(5.99)	(5.03)	(-0.81)	(-4.26)
Number of observations	598	277	288	505	488	240	496

Drop financial crisis years

Table 11: Matching results for all types of non-resources taxes, after dropping years after 2007

Treatment Variable: Stabilization fund	Non-resources tax revenues	Non-resources corporates taxes	Non-resources individual taxes	Non-resources direct taxes	Non-resources good and services taxes	Non-resources VAT taxes	Non-resources international trade taxes
(ATT) Resources taxes	0.270	0.817***	0.401**	0.781**	1.486***	0.967***	-1.551***
	(0.47)	(2.62)	(1.97)	(2.55)	(4.30)	(3.69)	(-6.28)
GDP growth	0.0764	1.006***	0.363*	1.012***	1.369***	1.677***	-1.299***
	(0.11)	(2.85)	(1.69)	(3.03)	(3.30)	(3.03)	(-4.95)
financial integration	0.490	0.826**	0.256	0.899***	1.362***	1.444***	-1.383***
	(0.77)	(2.45)	(1.11)	(2.72)	(3.11)	(2.59)	(-5.44)
total natural resources rents	1.545**	1.218***	0.613***	1.233***	1.638***	1.688***	-0.775**
	(2.26)	(3.89)	(2.80)	(3.56)	(3.46)	(3.20)	(-2.54)
total reserves growth	3.209***	1.009***	0.869***	1.400***	2.463***	0.963***	-0.596*
	(5.46)	(2.79)	(4.64)	(4.31)	(5.48)	(3.27)	(-1.85)
trade openness	1.918***	1.154**	1.067***	1.541***	2.096***	0.994***	-0.712**
	(2.67)	(2.43)	(5.83)	(4.87)	(4.88)	(2.95)	(-2.33)
dependency ratio growth	2.560***	0.990**	1.076***	1.256***	1.569***	1.648***	-0.176
	(4.01)	(2.21)	(5.92)	(3.73)	(3.81)	(5.16)	(-0.74)
icrg_bureaucraty	3.655***	1.190**	0.588	1.975***	2.541***	1.563***	-0.0556
	(6.11)	(2.02)	(0.77)	(4.59)	(6.76)	(5.36)	(-0.21)
Number of observations	691	362	365	584	571	186	581

6. Conclusion and policy implications

This paper empirically analyzes the impact of SWFs' creation on the mobilization of non-resources domestic revenues in such circumstances. We assume that creating a commodity fund tight the budget constraints and thus forces resource-rich countries' governments to have predictable resources. Creating a fund is a signal of a significant level of accountability for the government and encourages them to increase non-resource revenues to finance expenditures. We estimate the propensity scores over the period: 1980-2011. We found that the impact of having a sovereign wealth fund increases global non-resource tax revenues from 1.03% to 4.31% of GDP in resource-rich countries. Non-resources corporate taxes, non-resources individual taxes, non-resources good and services taxes, and non-resources value-added taxes are significantly and positively impacted by the treatment, except international trade tax revenues, which are negatively impacted.

To the best of our knowledge, this paper is the first to analyze the empirical effect of sovereign wealth funds in general on non-resource taxes. We found a statically significant and positive effect on these funds on all types of taxes, except for international trade taxes. When there are well managed, sovereign wealth funds can solve the natural resources curse by helping to gather more domestic revenues.

Appendix A

a- List of sovereign wealth funds [25]

Country	Fund name	Assets	Data sources	Inception	Abolishment	Fund resources
Algeria*	Revenue Regulation Fund	50	(b)	2000		Oil & gas, taxation surpluses
Azerbaijan*	State oil fund	34.93	(a)	1999		Oil
Bahrain*	Mumtalatak Holding Company Reserve Fund for strategic Projects	10.74	(a) & (f)	2006		
Botswana*	Pula Fund	5.7	(b)	1993		Diamond and minerals
Brunei	Brunei Investment Agency	40	(a)	1983		Oil
Chad*	Revenue Management Plan 2008			1998	2008	Oil
Chile*	Economic and social stabilization Fund	15.2	(b)	2006		Copper
Colombia*	Oil Stabilization fund (FAEP)		(f)	1995		Oil
Ecuador *	Oil Stabilization fund (FEP) Fund for Stabilization, Social and Productive Investment		(f)	1999	2007	Oil
Ecuador *	Funds for stabilization, social and productive investment, and reduction of Public Debt (FEIREP)			2002	2005	Oil
Ecuador *	Saving and contingency Fund (FAC)			2005	2008	Oil
Equatorial Guinea	Fund for Future Generations	0.08	(b)	2002		Oil
Gabon	Fund for Future Generations	0.38	(b)	1998		Oil
Ghana	Petroleum Funds	0.45	(b)	2011		Oil
Iran*	National Development Fund of Iran***	62	(b)	2000		Oil & gas
Iraq	Development Fund for Iraq	18	(b)	2003		Oil
Kazakhstan*	National Fund for the Republic of Kazakhstan	77	(a)	2000		Oil gas metals

[25] * oil producing countries, *** funds that are closed or replaced

Kazakhstan	National Investment Corporation of National Bank of Kazakhstan	2	(b)	2012		Oil
Kazakhstan	Samruk Kazyna JSC	77.5	(b)	2008		Non Commodity
Libya*	Libyan Investment Authority	66	(a)	2006		Oil
Mongolia*	Fiscal Stability fund	0.3	(b)	2011		Mining
Mauritania*	National Fund for Hydrocarbon Reserves	0.3	(b)	2006		Hydrocarbons
Mexico*	Oil Revenues Stabilization Fund	6	(b)	2000		Oil
Nigeria*	Excess Crude Account****	1.35	(b)	2003		Oil
Norway*	Government Pension Fund-Global	895.1	(a)	1990		Oil
Oman*	Investment Fund	6	(b)	2006		Oil
Oman*	State General Reserve Fund	13	(b)	1980		Oil & gas
Papua New Guinea*	Mineral resources Stabilization Fund (MRSF) Papua New Guinea Sovereign wealth Fund			2011		Gas
Peru*	Fiscal Stabilization Fund	7.1	(b)	1999		
Russia	Direct Investment Fund	13	(b)	2011		
Russia	National Welfare Fund	79	(b) & (f)	2004		Oil
Russia	Reserve Fund and National Welfare Fund	88.9	(b)	2008		Oil
Sudan *	Oil Revenue Stabilization Account		(f)	2002		Oil
Timor Leste*	Petroleum Fund	16.83	(a)	2005		Oil & gas
Turkmenistan *	Stabilization Fund		(b) & (f)	2008		Oil and gas
Venezuela*	Macroecnomic stabilization Fund (FEM)	0.8	(b)	1998		Oil

Sources: (a) Sovereign wealth fund lab, (b) Sovereign Wealth Fund Institute[26], (c) (Carpantier, J. F., & Vermeulen, 2014)), (Truman, 2008) (Truman, 2013), (Naotaka, 2014)

[26] The data on sovereign wealth funds were collected on October 26th , 2015

GENERAL CONCLUSION AND POLICY RECOMMENDATIONS

Natural resource management remains a crucial issue for developing countries. We are at a turning point where giant oil and gas discoveries are becoming more and more frequent in these countries, with technological advances allowing for better exploration of some geographical regions. Sub-Saharan African countries, for example, have missed out on various growth booms driven by technological advances in history, and therefore need to use the opportunity to leverage their natural capital by addressing the anticipated adverse effects of such booms. Good knowledge of the mechanisms that generate the curse of natural resources is necessary to achieve this.

Therefore over the years, scientific studies have corroborated the harmful effects of oil and gas windfalls on outcomes variable, supporting the issue of the development of resource-rich low-income countries very complex but possible as long as natural resources are well managed since their discovery. This thesis highlights some of the adverse effects on fiscal policy that have not reached consensus in the empirical literature.

In the first chapter, we examine the effect of extractive natural resources on the probability of developing countries defaulting on their sovereign debt and being in debt distress. The results confirm that giant oil and gas discoveries increase the risk of debt distress, especially for countries that do not have a good export diversification policy. This result is noteworthy because we have focused only on sub-Saharan African countries that have already received debt relief through the Heavily Indebted Poor Countries (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI).

The second chapter shows the impact of oil and gas discoveries on the composition of public expenditures in developing countries. It emphasizes the harmful effects of these discoveries on health and education spending. It has shown that governments privilege less productive and favor more discretionary spending categories, like military and social protection spending. The results of this

chapter contribute to the reflection on how to achieve the Sustainable Development Goals, especially the social objectives.

The third chapter gives empirical evidence that sovereign wealth funds could be a solution for addressing the volatility of natural resource revenues and the issue of non-resource tax mobilization. We have shown that imposing an additional fiscal constraint on resource-rich states encourages better revenue mobilization across non-resource sectors. This result contributes to the discussion of options for achieving the objectives of the Marrakech Consensus, which emphasized the importance of better domestic revenue mobilization.

Regarding policy recommendations, this thesis highlights that governments in resource-rich countries need to build strong institutions that use resources from the natural resource sector to boost other emerging sectors. This policy of diversification of exports and revenues will help fight against the volatility of revenues. This could be achieved by implementing a sovereign wealth fund managed with transparency, with clearly stated sourcing mechanisms and stated objectives of allocation of these revenues to different sectors.

The sectors to be covered by the action of this fund will be the sectors affected by the exploitation of natural resources. The revenues from this fund could be used to foster positive incentives for industrialization by boosting the embryonic industrial sector, direct subsidies to compensate for the loss of competitiveness of this sector. It is the case of Mauritius, which has overcome its potential disadvantages of being resource-rich by adopting a manufacturing export policy that diversified its economy.

To overcome the failures experienced by the various SWFs initiatives, notably Chad's case, policymakers have to implement a transparent recruitment policy for the SWF's executive committee and publish regular activity reports mentioning the objectives and results achieved during the year. This monitoring role could be delegated to a supra-national agency composed of international experts

in extractive resources exploitation and thus less inclined to collaborate with lobbies in each country. This proposition will increase leaders' accountability and help achieve the objectives of diversifying exports and financing key development sectors such as education and health. This suggestion is broadly inspired by the concept of "independent fiscal agencies" proposed by Debrun, Hauner, & Kumar (2009) for fiscal rules.

This thesis has faced some limitations that it is important to highlight:

- the problem of actualization of oil and gas discoveries data which required the study period to end in 2010
- the opacity of information on the use of resources and the objectives of SWFs
- the recent introduction of independent fiscal councils, which made difficult a comparative empirical study with SWFs

Regarding the future research perspectives, we should get rid of the confirmation bias (Wason, 1960), which leads us to confirm the existence of a natural resource curse and analyze successful actions used in terms of natural resource management following the study of Lashitew, Ross, & Werker (2021). Future research papers will be able to benefit from the availability of data on the measures adopted to manage the harmful effects of the natural resource curse (such as Extractive Industries Transparency Initiative – EITI launched in 2002 and Extractives Dependence Index -EDI (Hailu & Kipgen, 2017) that can be used to monitor country's dependence on the extraction of oil, gas and mineral resources)

To conclude, we can say that the answer to the natural resource curse should be multi-dimensional thus needs to involve several stakeholders, including, for example, recent developments in social psychology developed in the study of Collier (2017).

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Résumé en français

1. Importance des ressources naturelles dans l'évolution de l'activité économique mondiale

Les différentes périodes de la civilisation humaine, ont été jalonnées par des découvertes de ressources naturelles. Les richesses du sous-sol quand ont les découvraient, permettaient d'améliorer la technologie et les outils utilisés et de passer à une étape plus avancée. Certes l'ère du Paléolithique (environ 3 000 000 à 10 000 avant J.C) et du Néolithique (environ 10 000 à 3 300 avant J.C) ont été caractérisées par l'industrie lithique (développement d'outils en pierre taillée par les humains), toutefois les différents stades qui les succèdent mettent en exergue « l'ère des métaux ». Au sortir du Néolithique commence l'âge du Bronze (environ 3 000 à environ 1 000 avant J.C dans les régions d'Afrique du Nord, du Moyen Orient et d'Europe), la civilisation humaine se familiarise avec la toute nouvelle technique de métallurgie. Elle permet désormais l'extraction, et l'utilisation de métaux précieux et d'alliages dont l'exploitation n'a pu se faire que dans les zones disposant de gisements de cuivre notamment. L'exploitation du bronze a notamment permis de faire évoluer la technologie et de fabriquer de nouveaux types d'armements et autres outils humains. Avec l'apparition de la métallurgie, l'économie se complexifie, les activités se spécialisent au sein des clans ; apparait ainsi une rupture sociale et économique basée sur la spécialisation dans les activités de production.

A partir des années 1 000 avant J.C, nous rentrons dans l'âge de fer qui précède directement l'ère moderne. Nous pouvons à juste titre affirmer que l'ère moderne correspond à l'âge des hydrocarbures avec trois avancées majeures :

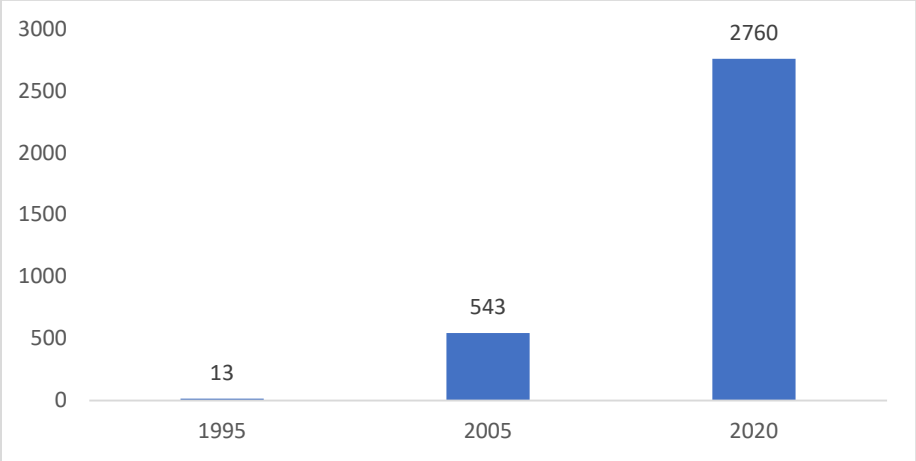
- l'ère du charbon du pétrole et du gaz avec la création de la machine à vapeur dans les années 1800, qui a permis la production massive d'énergie à base de charbon ;
- en 1850, nous avons la création des premiers moteurs à combustion interne utilisant le pétrole, qui avant le moteur à combustion interne était utilisé pour des usages très limité ;.
- et la création de la turbine à gaz, qui a permis d'utiliser le gaz naturel pour créer d'énormes quantités d'énergie.

Ces évènements montrent dans quelle mesure, les minerais puis les hydrocarbures ont jalonné l'économie en permettant une évolution technologique des régions ayant connu ces découvertes et la dissémination de la technologie dans le monde. Cette thèse s'intéresse aux hydrocarbures qui ont soutenu la révolution industrielle et l'ère moderne en générale. Ce constat est d'autant important que les pays à faibles revenus ont connu plus tardivement des découvertes. Celles-ci ont fondamentalement changé la structure économique de ces pays ce qui a conduit les économistes du XXème siècle à s'intéresser à la question du paradoxe entre l'importance du capital naturel de ces pays et leur croissance économique. Ce paradoxe plus connu sous le nom de « malédiction des ressources naturelles » bénéficie d'un intérêt croissant dans la littérature économique comme le démontre le tableau des articles publiés sur la question depuis 1995.

2. L'intérêt croissant de la communauté scientifique sur la question de la malédiction des ressources naturelles dans les pays en développement.

Le graphique 1 démontre l'attention de la communauté scientifique sur l'impact des ressources naturelles. Depuis l'étude empirique pionnière de Sachs & Warner (1995) les études n'ont cessé de croitre. De 2005 à 2014, il y avait quatre fois plus de publications scientifiques sur la malédiction des ressources naturelles que sur la période 1995-2004 et la tendance en 2021 est à la hausse.

Figure 16: Number of academic papers on "natural resource curse" published on Google Scholar from 1995-2020



Source : Data from 1995-2020 retrieved from Papyrakis (2017) and expanded by the author

3. Fondements de la théorie de la malédiction des ressources

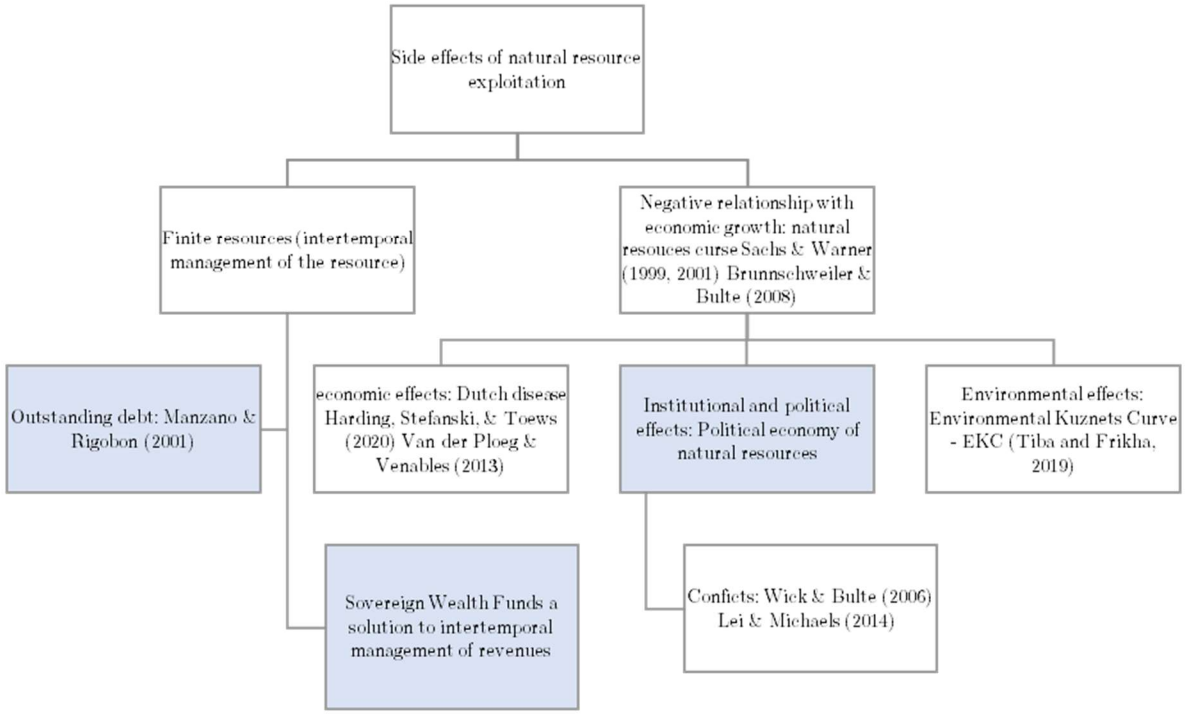
Badeeb et al. (2017) décrit l'évolution de la théorie sur les ressources naturelles, commençant à la fin du XIXe siècle avec les travaux d'Adam Smith et David Ricardo sur les avantages. Période à laquelle l'impact des ressources naturelles était associé à l'accroissement de la production sur le long terme. Cela s'explique par le fait que ces ressources sont utilisées directement ou indirectement dans processus de production. Un pays richement doté en ressources naturelles avait donc un avantage comparatif certain sur les autres pays : plus grande frontière de possibilité de production. La malédiction des ressource naturelles peut-être aussi reliée à la littérature sur l'hypothèse de Prebisch (1950), Singer (1950) sur le déclin des termes de l'échange, qui prédit à long terme le déclin du prix des matières premières à raison de l'élasticité-revenu de la demande mondiale dû au progrès technique et la structure des marchés. La littérature sur la malédiction des ressources tire également ses fondements dans la théorie de Balassa (1964) Samuelson (1964) qui montre l'impact des écarts de productivité entre les pays sur le pouvoir d'achat des travailleurs du secteur des biens échangeables. Dans notre cas cela reviendrait à analyser l'impact des écarts de productivité relative et le pouvoir d'achat des

travailleurs du secteur industriel. Dans la même ligne émerge ensuite les analyses de Corden & Neary (1982), Corden, (1984), Auty (1993, 1994), portant sur le syndrome hollandais qui se manifeste par le déclin du secteur manufacturier consécutivement à la hausse des prix des biens non échangeables à la suite du boom dans le secteur des ressources naturelles.

A partir des années 90 apparaissent alors les premières études empiriques sur le paradoxe entre abondance des ressources naturelles de certains pays en développement et leur faible aptitude à fournir de la richesse économique. L'étude pionnière de Sachs & Warner (1995) montre qu'à mesure que la dépendance au ressources naturelles mesurée par exportations des ressources naturelles dans les exportations totales sur la période 1971 augmente, cela induit une diminution du taux de croissance économique entre 1971 et 1989. Cette première étude empirique soutenue par plusieurs auteurs dont Humphreys, Sachs, & Stiglitz (2007), décompose l' effet globale des ressources naturelles (minières dans cet article) en inégalité verticale (écart de pauvreté entre les couches sociales) et inégalité horizontale (écart de pauvreté entre les pays). La thématique est d'actualité et explique l'évolution des classes de revenues entre les pays. Les pays de la zone du Moyen Orient - Afrique du Nord, de l'Afrique subsaharienne ou encore de pays de l'Amérique Latine regorgent d'importantes ressources naturelles minières – pétrolières tout en expérimentant une faible croissance économique comparativement au groupe des tigres asiatiques Japon, Corée, Taiwan, Singapour et Hong Kong, qui sont des pays insulaires ayant réussi à amorcer un développement économique fulgurant malgré le fait que soit des pays pauvres en ressources naturelles. Différentes études économiques ont analysé l'impact de la dépendance des ressources naturelles sur différents agrégats macroéconomiques comme la croissance économique (Sachs & Warner, 1999, 2001; Brunnschweiler & Bulte, 2008); les taux de change (Harding, Stefanski, & Toews, 2020, Van der Ploeg & Venables, 2013); la fiscalité (Crivelli & Gupta, 2014); la politique budgétaire (El Anshasy & Katsaiti, 2013); la démocratie (Tsui, 2011, Bjorvatn, et al. 2012) et Ross, 2015); les conflits (Wick & Bulte, 2006, Lei & Michaels, 2014, Farzanegan, et al. 2018); la qualité de l'environnement (Tiba & Frikha, 2019), et le développement

financier (Wang, et al., 2021); la dette Manzano & Rigobon (2001), entre autres. Le graphique ci-dessous schématise l'arborescence des effets négatifs des ressources naturelles sur les différents sujets, en mettant en exergue en bleue les apports de cette thèse.

Figure 17: Arborescence des différents effets des ressources naturelles



Source: Author

La volatilité des prix demeure un des facteurs déterminants de la malédiction des ressources Van der Ploeg & Poelhekke (2009), les auteurs l'explique par le fait que la volatilité des prix est transmise à l'économie sous forme d'une brusque variation des ressources publiques, dommageable pour la croissance, essentiellement dépendante de ces ressources. Ils démontrent alors qu'en dehors de ce phénomène de volatilité des ressources, l'impact des ressources naturelles est positif et significatif. L'effet indirect négatif de la « volatilité des ressources publiques » est seulement induit par les chocs de prix des matières premières. L'instabilité est d'autant plus dommageable pour la croissance à long terme que les effets des chocs sont asymétriques. Les chocs de prix négatifs (positifs) conduisent à un resserrement (relâchement) de la contrainte budgétaire. Des ajustements sont alors nécessaires

d'autant plus pour les Etats ayant une faible intégration sur les marchés financiers et un faible niveau de croissance des secteurs « hors- ressources ». Ces économies fortement dépendantes des pétrodollars sont en effet plus enclines à adopter des stratégies de dépenses corrélées avec le niveau de prix des ressources. C'est ainsi qu'est apparu le concept « d'éléphant blancs » assimilés à des dépenses populistes très peu rentables à long terme réalisées par le gouvernement en place dans le but de gagner des suffrages. Les articles de Tornell & Lane (1999) et Farzanegan (2011) étayent ces aménagements politiques. Hicks (1991) est en revanche s'interroge sur la nature des ajustements budgétaires dans le cas où le poids de la dette est déjà élevé dans les pays en développement où chaque poste de dépense à son importance aussi bien sur le plan politique qu'économique. L'ajustement pose des vraies questions d'économie politique, étant donné que les décisions des politiques au pouvoir au temps t, ont des répercussions sur leur possible réélection en t+1. L'auteur trouve que les dépenses militaires et sociales sont les plus stables tandis que le secteur des infrastructures et les autres secteurs productifs sont ceux qui en pâtissent le plus. Les revenues issues du secteur des ressources est un moyen de renforcement de la sécurité, de développement d'un Etat fort à travers l'accroissement des dépenses militaires. Chun (2010) a calculé l'élasticité des ressources issues du secteur du pétrole sur l'accroissement des dépenses militaires. Ces résultats montrent que les dépenses militaires sont inélastiques par rapport aux variations des revenus pétroliers, rendant ainsi inapproprié les sanctions autrefois prises contre l'Iran à cause de ses ambitions nucléaires. L'étude est basée, pour la période 1997-2007, sur cinq pays. Pour une revue de la littérature plus complète sur la malédiction des ressources naturelles en général consulter les articles de Frankel (2012), Badeeb et al., (2017), et Papyrakis (2017) et pour une revue empirique consulter l'article de Van Der Ploeg & Poelhekke (2017)

4. De la dépendance aux ressources à l'abondance des ressources : les indicateurs de richesse en ressources naturelles

La premières vague de papiers empiriques portaient sur la dépendance des ressources naturelles avec des indicatieurs en niveau mesurant la richesse totale des pays (Sachs & Warner, 1995, 2001; Gylfason,

2001; Stijns, 2005). Vient ensuite l'étude de Brunnschweiler & Bulte (2008) qui introduit la distinction entre dépendance en ressources naturelles et l'abondance en ressources naturelles. Les auteurs expliquent que la première mesure souffre de problème d'endogénéité, du fait que le dénominateur inclus le secteur des ressources naturelles et d'autres déterminants de la croissance économique. Le fait d'utiliser une mesure relative à la taille de la population, ou de considérer les réserves naturelles permets de corriger le biais d'endogénéité et de mieux prendre en compte l'abondance au lieu de la dépendance jusque-là utilisée. En corrigeant ce biais, l'effet négatif des ressources naturelles se serait plus significatif sur la croissance économique. Ce papier a été déterminant pour la suite de la littérature économique qui désormais utilise majoritairement les rentes naturelles par habitant. Les papiers postérieurs à Brunnschweiler & Bulte (2008), ont des résultats plus variés dépendant non seulement de l'indicateur de richesse des ressources naturelles mais aussi du modèle économétrique utilisé.

4.1. Les différents indicateurs utilisés dans la littérature sur la malédiction des ressources naturelles

En fonction des périodes de parution des articles, la mesure de la variable indiquant les ressources naturelles varie. Les études portant sur la dépendance des ressources naturelles sont rapportées à l'activité économique ou en pourcentage de l'assiette dans sa globalité. Nous présentons ci-dessous la liste de quelques-uns de ces indicateurs inspirés de Badeeb et al., (2017):

- les exportations de ressources naturels en pourcentage du PIB ;
- les rentes de ressources naturelles en pourcentage du PIB ;
- le ratio du capital naturel dans la richesse nationale ;
- les exportations de ressources naturelles dans le total des exportations.

A la suite de la critique de Brunnschweiler & Bulte (2008), nous avons une deuxième vague d'articles qui tient compte du problème d'endogénéité et utilise plutôt les variables de ressources naturelles rapportées à la population: c'est le concept de l'abondance en ressources naturelles.

4.2. Limites des indicateurs existants et nouvelles approches : les grandes découvertes de pétrole et de gaz

4.2.1. La malédiction des ressources naturelles remise en question

L'étude de Brunnschweiler & Bulte (2008) a mis en lumière de nombreuses études dont les résultats sont différents de la conclusion habituelle de malédiction des ressources naturelles. Pour Boyce & Herbert Emery (2011) par exemple, les résultats négatifs des études sur la dépendance des ressources naturelles sont des corrélations et n'induisent pas forcément une causalité. Les auteurs soutiennent que l'impact globale de l'abondance des ressources naturelles sur la croissance économique est négatif, mais positif lorsque l'on considère les niveaux de revenus.

Lederman & Maloney (2006) utilise le ratio des exportations de produits primaires sur les exportions de total de produits et les exportations primaires rapportés au PIB sur la période 1980-1999 et arrivent à la conclusion que l'abondance en ressources naturelles n'est ni une malédiction ni une bénédiction à condition que cette richesse soit combinée à de l'innovation. Sur un panel de pays membres et non membres de l'OPEC, Alexeev & Conrad (2009) pointent également le problème du dénominateur des indicateurs de dépendance aux ressources naturelles. Ils proposent deux nouvelles mesures et trouvent un résultat positif : les réserves de ressources naturelles par tête et le PIB de pétrole rapporté au PIB initial total.

Cavalcanti, Mohaddes, & Raissi (2011) allient des méthodes d'estimation sur données de panel non stationnaires ainsi que des indicateurs d'abondance (production pétrolière réelle et réserves pétrolières comme approximations de la dotation en ressource). Ils trouvent que l'abondance en ressources naturelles induit une augmentation du niveau de revenu et un taux de croissance positif. Toutefois ces résultats positifs peuvent être amélioré en adoptant de meilleures institutions.

4.2.2. Nouvelles approches quantitatives : découvertes majeures de gisements pétrole et de gaz

De nombreuses études récentes ont mis en exergue une nouvelle approche permettant de mieux identifier l'impact des ressources naturelles : il s'agit de l'utilisation des découvertes majeures de gisements de pétrole et de gaz. Elles sont considérés comme expérience quasi-naturelle, dont les effets d'anticipation dans l'économie sont observables à moyen terme. L'étude d'Arezki, Ramey, & Sheng (2017) a permis de vulgariser cette approche, inaugurant ainsi une nouvelle vague d'articles empiriques reliant les découvertes majeures de pétrole et de gaz estimées à un minimum 500 millions de barils et les agrégats macroéconomiques. Le challenge était d'évaluer le moment où les anticipations ont changé suite à l'annonce de la découverte et d'en évaluer les effets. Ils montrent que la réaction des autorités à la découverte des ressources est antérieure à l'exploitation du premier baril d'environ cinq ans. Ils concluent à une baisse du PIB, du compte courant et une hausse de l'employabilité dû à l'appréciation du taux de change réel.

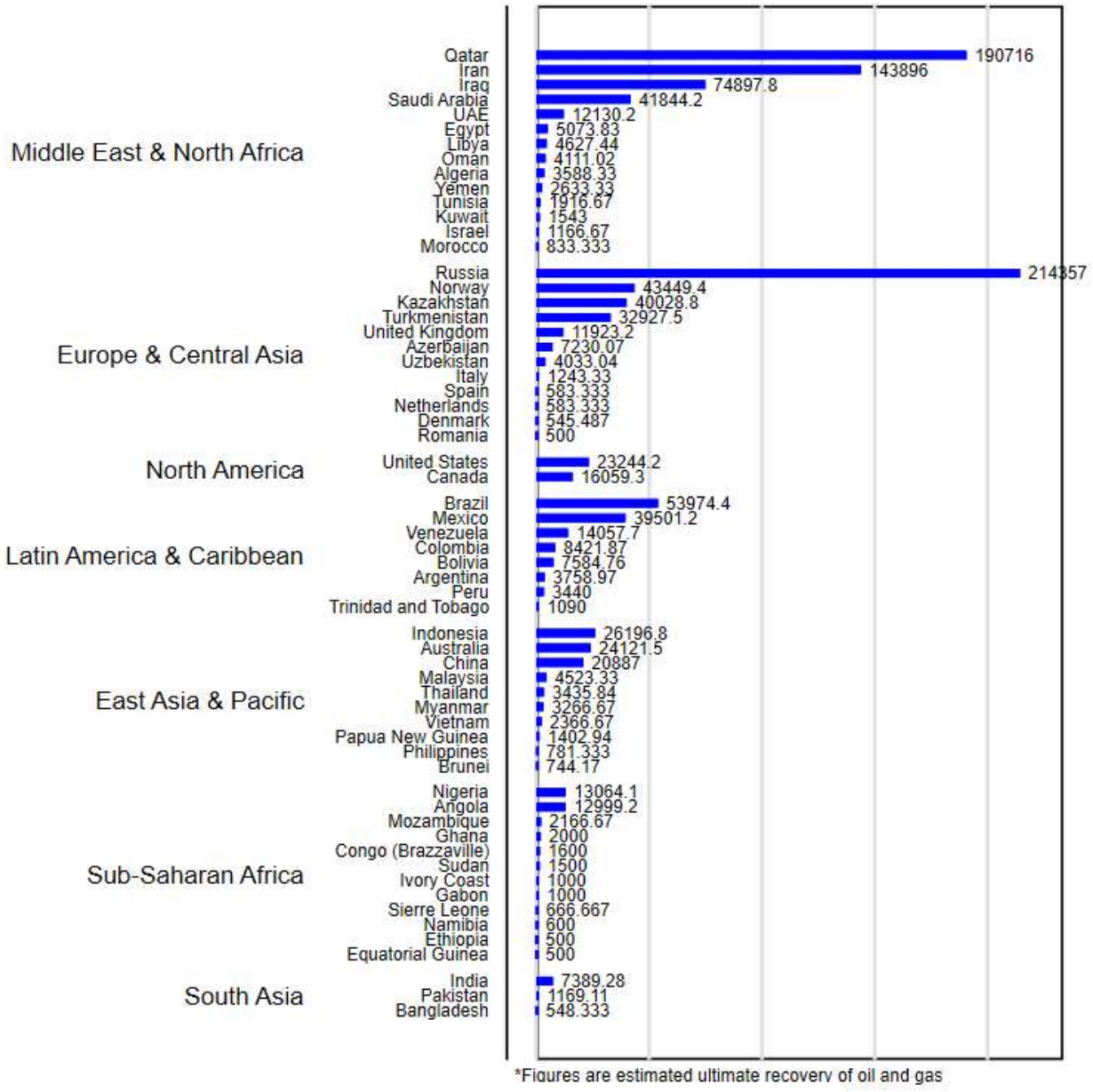
Tsui (2011) fait le lien entre découvertes majeures de pétrole et la démocratie et abouti à la conclusion que la découverte de 100 millions de barils de pétrole induit une diminution du niveau de la démocratie d'environ 20%. L'étude de Stark and Smith (2017) portant sur la présentation des découvertes majeures de pétrole et de gaz, fait remarquer que les découvertes qui se font maintenant en eaux plus profondes, a augmenté d'environ 5%. Elles portent essentiellement sur le gaz de schiste, produit essentiellement aux Etats-Unis. Cette thèse s'inscrit dans la continuité de ces études. Les graphiques qui suivent décrivent les données de découvertes.

<u>Répartition des gisements par région</u>

Le graphique 3 montre la répartition des découvertes par région en fonction de l'estimation de la valeur nette actuelle du gisement. Nous remarquons que les plus grands gisements sont concentrés dans les pays du Moyen Orient – Afrique du Nord. La région d'Afrique subsaharienne est la deuxième région la moins dotée en gisements de pétrole et de gaz. Le Nigéria et l'Angola sont en

tête du classement, suivis du Mozambique avec moins d'un quart de la valeur nette actuelle du gisement de l'Angola.

Figure 18: Taille des gisements de pétrole et de gaz par pays et région, entre 1970 et 2010

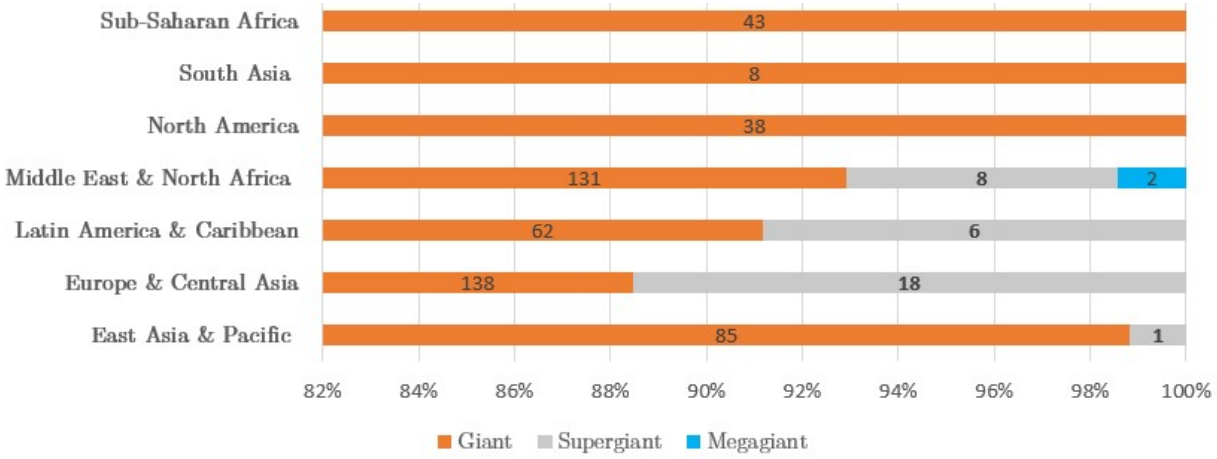


Source : Author, based on Horn's (2014) data

La figure 4 nous indique que les super et méga découvertes de pétrole et de gaz sont concentrés dans les régions où il y a le plus de puits de pétrole et de gaz, ce sont

essentiellement les zones MENA et ECA. La taille et le nombre des découvertes sont corrélés. La zone MENA est la seule à avoir connu deux « super » découvertes de pétrole.

Figure 19: Répartition de la découverte de pétrole et de gaz par taille et par région

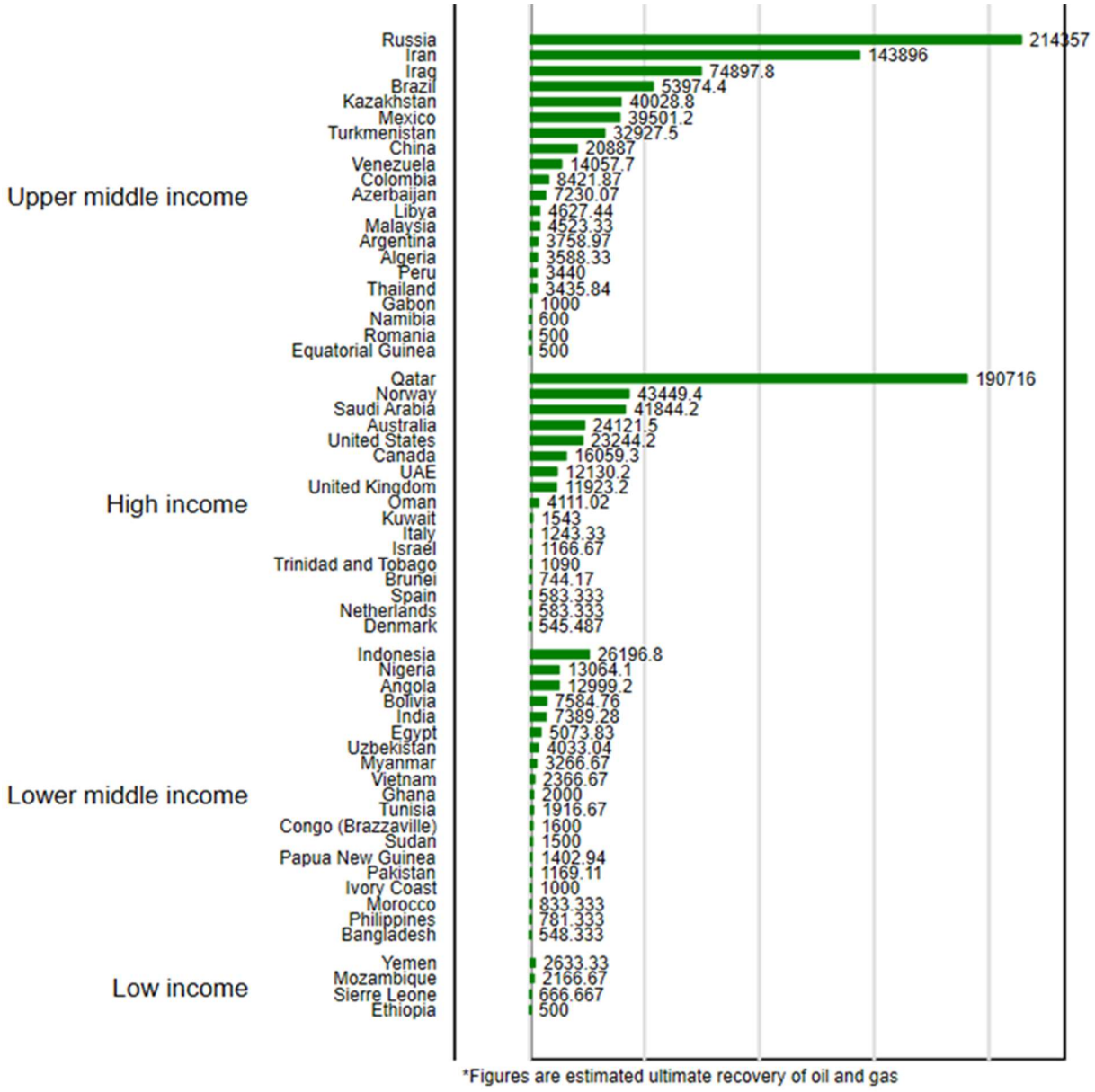


Source : Author, based on Horn's (2014) data

Répartition des gisements par groupe de revenu

Nous remarquons dans la figure 5 que les pays à faible revenu et les pays à revenu intermédiaire de la tranche inférieure sont les moins dotés en gisements d'hydrocarbures. Cela suggère une correlation négative entre le niveau de revenu et valeur totale actualisée de pétrole de gaz dans les pays.

Figure 20: Répartition des gisements de pétrole par groupes de revenu

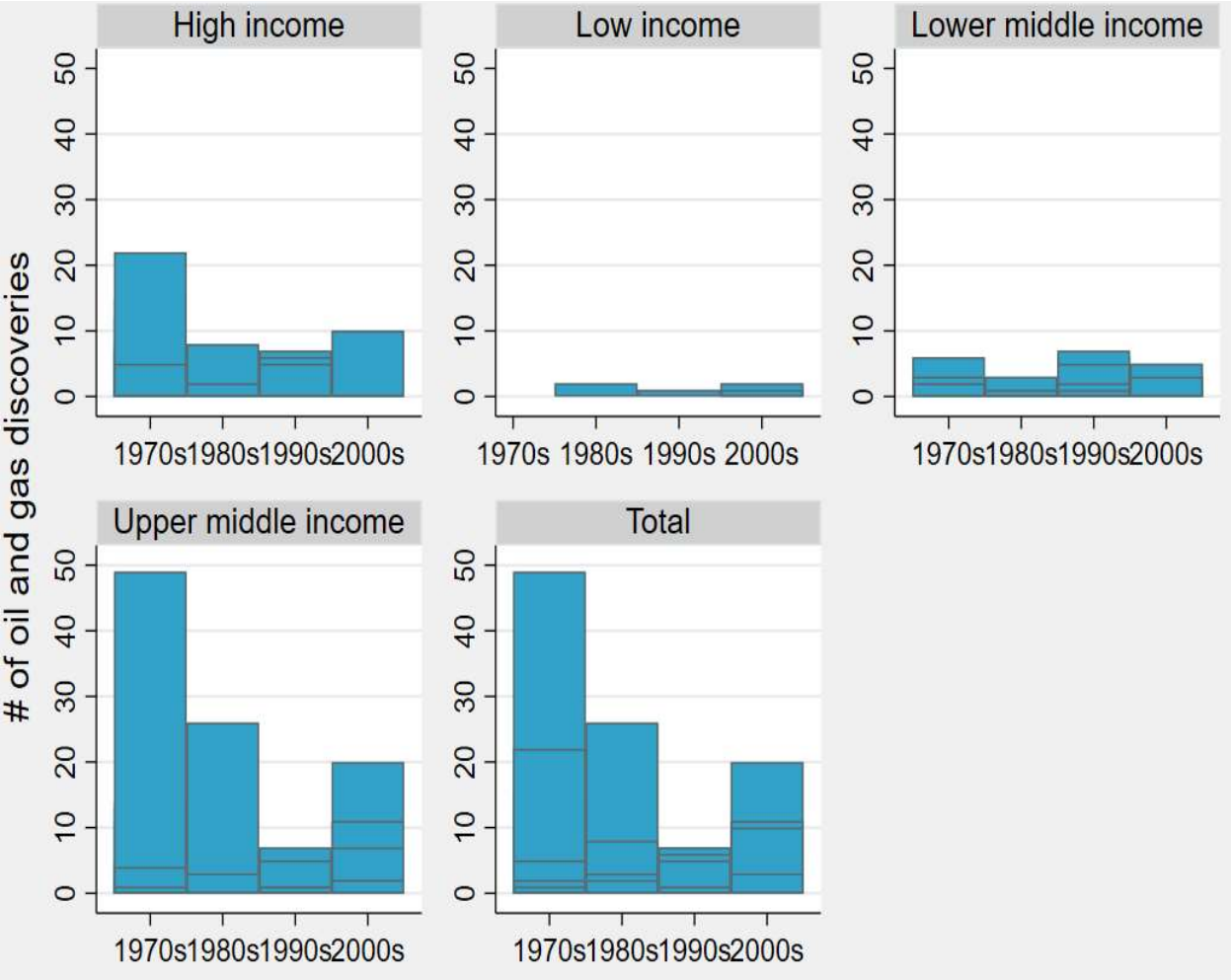


Source : Author, based on Horn's (2014) data

Répartition des découvertes des grands gisements par groupe de revenus

La figure 6 indique que les grandes découvertes de pétrole et de gaz ont eu lieu en début de période (décennie 70) pour l'ensemble des pays à revenu intermédiaire de la tranche supérieure et les pays à haut revenu. Ce qui laisse présager que les pays à faible revenu seront bientôt dans une

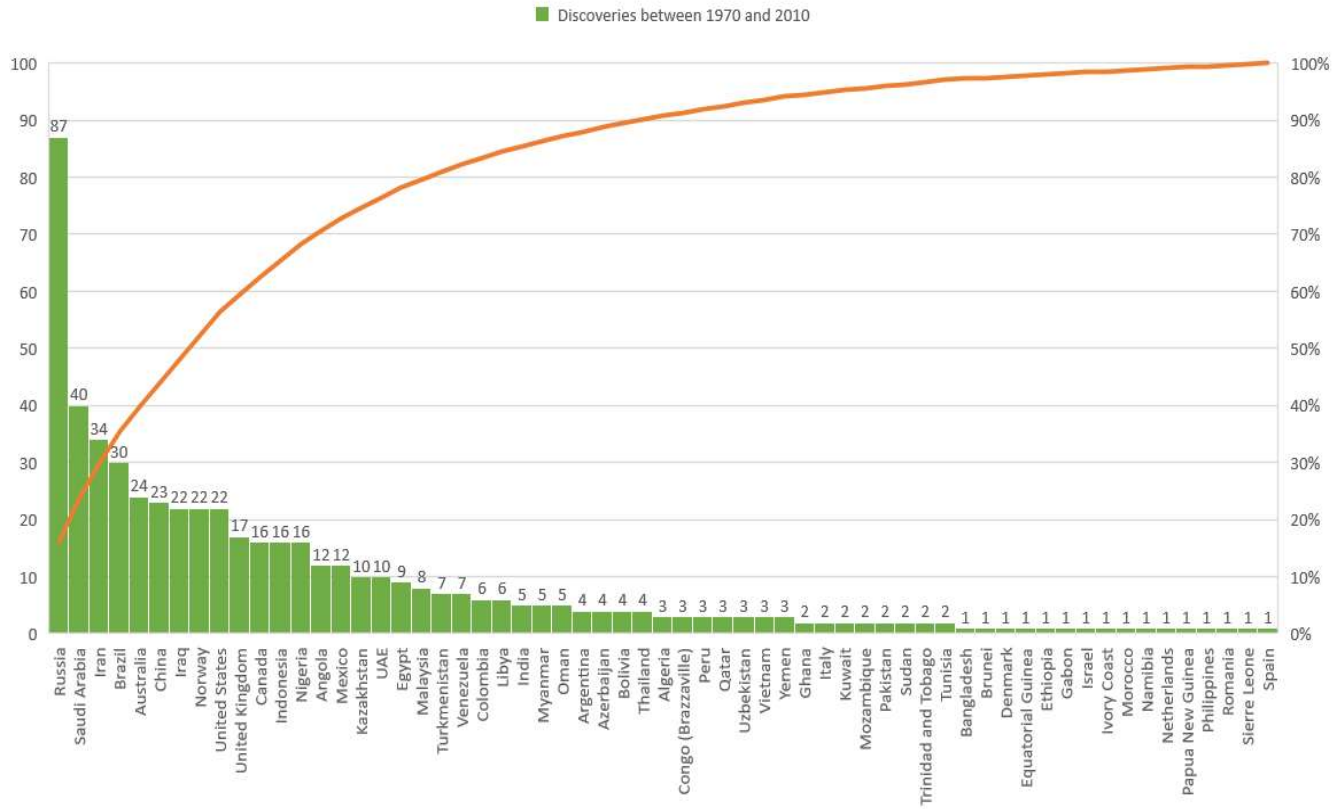
Figure 21: Répartition des découvertes par décennies et groupes de revenus



dynamique de rattrapage. Le faible nombre de grandes découvertes dans les pays à faible revenu soutient l'idée que les découvertes seraient endogènes, exposé dans le chapitre 2.

D'après la figure 9, la Russie est le pays qui a connu le plus de découvertes sur la période 1970-2010. Les découvertes sont très concentrées, sept pays concentre près de 50% des découvertes majeures de pétrole et de gaz.

Figure 22: Nombre de découvertes par pays entre 1970 et 2010



Source : Author, based on Horn's (2014)

Résumé des thèmes abordés dans les différents chapitres de ce travail

Cette thèse explore les défis liés à la gestion des ressources naturelles. Dans le premier chapitre nous traitons de l'effet des grandes découvertes de pétrole sur les épisodes de crise de la dette dans les pays d'Afrique subsaharienne entre 1970 et 2010. Nous testons empiriquement le lien entre ces chocs de revenu et la dette extérieure en utilisant le modèle log-log complémentaire à effet aléatoire. Les résultats montrent que les découvertes géantes de pétrole augmentent le risque de détresse d'environ 20 %. Ce résultat met en évidence une question cruciale car la plupart des pays subsahariens ont déjà bénéficié d'un allègement de leur dette par le biais de l'initiative en faveur des pays pauvres très endettés (PPTE) et de l'initiative d'allègement de la dette multilatérale (IADM). Nous expliquons l'effet négatif de cette richesse "inattendue" par l'augmentation des dépenses publiques et l'accès

croissant des pays africains aux prêts commerciaux. Cela peut induire des problèmes intergénérationnels lorsque l'exploitation des ressources entraîne des niveaux d'endettement insoutenables pour la génération future. Nous constatons que l'effet demeure dans les économies concentrées et disparaît dans les économies diversifiées. Il est également à noter que la matière permet de réduire ce risque. Nos résultats sont robustes à divers contrôles de robustesse.

Dans le second chapitre nous analysons l'impact des découvertes de gaz et de pétrole sur la composition des dépenses publiques sur la période 1980-2010 dans 96 pays en développement. Dans ce chapitre, nous supposons l'endogénéité des grandes découvertes de gaz et de pétrole par rapport aux institutions. L'estimateur adapté dans cette situation est inspiré du modèle *control function* de Wooldrige (2010) : *endogenous treatment effect*. Les instruments choisis dans la littérature économique sont la superficie du pays, le statut d'enclavement du pays, et le niveau de démocratie. Nous montrons un effet d'éviction des dépenses militaires sur les dépenses sociales (santé et éducation). L'effet négatif est persistant sur une décennie pour les dépenses de santé, remettant en question l'atteinte des Objectifs de Développement Durable. Les résultats indiquent également que les découvertes de gaz et de pétrole représentent une aubaine pour ces pays pour équiper le secteur de la défense.

Dans le troisième chapitre, nous apportons une réponse empirique au problème de la mobilisation des recettes fiscales nationales dans les pays riches en ressources. Nous nous concentrons sur les taxes non liées aux ressources dans 60 pays en développement, au cours de la période 1980-2010. Nous montrons un impact positif et statistiquement significatif de la création de fonds souverains sur la mobilisation des taxes non liées aux ressources, à l'exception des taxes sur le commerce international. Cet effet positif s'explique par le fait que les fonds souverains absorbent une partie des revenus issus du secteur des ressources naturelles, les rendant moins volatiles. Les fonds souverains exercent également une certaine

contrainte budgétaire liée, ce qui favorise la collecte des impôts. Le flux de trésorerie généré par le fonds est également utilisé pour améliorer la croissance du secteur non lié aux ressources, afin de générer des revenus plus prévisibles. Pour chaque pays, outre l'analyse de l'effet des fonds souverains, nous nous concentrons également sur les fonds de stabilisation car leurs premiers objectifs déclarés sont de lisser les dépenses publiques et de maintenir des revenus prévisibles. Ces deux objectifs impliquent nécessairement d'assurer une augmentation régulière des taxes sur les ressources non naturelles.